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EFFECT OF ORGANIC AND INORGANIC FERTILIZERS ON ROOT TRAITS, NITROGEN CONTENT AND YIELD OF *Sesamum indicum* (L.) UNDER SALINITY CONDITION

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ABSTRACT

Pot culture experiment was conducted during 2015-2016 to evaluate the effects of application of various plants nutrients viz., organic manure (farmyard manure and vermicompost) and inorganic fertilizer (NPK fertilizer) on root length, root biomass, Nitrate reductase activity (NRA), total nitrogen content and yield of sesame. Plants were subjected to different salinity regimes of NaCl [100mM (9.85 dSm⁻¹), 150 mM (15.78) and 200mM (21.8 dSm⁻¹)]. Untreated plants served as control. Plants were analyzed for root traits, nitrate reductase activity and nitrogen content from 30 days to 70 days at every ten days interval. Yield was recorded at 80 days of plant growth. Salinity caused decrease in the root length, root biomass, nitrate reductase activity, total nitrogen content and yield of the plants. However, application of the nutrients increased these parameters effectively in 100 mM NaCl treated plants and the increment was more pronounced when the plants were treated with vermicompost.

INTRODUCTION

Sesame [*Sesamum indicum* (L.)] is an annual herb which is economically important oil crop and usually raised as *Kharif* crop. It prefers a well-drained sandy loam soil with adequate moisture. Sesame is widely used in food, nutraceutical and pharmaceutical industry because of its high oil, protein and antioxidant content. Dietary sesame lignans have effects such as reducing liver damage and serum cholesterol level, increasing vitamin E activity and α -tocopherol availability (Ikeda *et al.*, 2003).

Saline soils occupy 7 % of the earth's land surface (Ruiz-Lozano *et al.*, 2001). At present, out of 1.5 billion ha of cultivated land around the world, about 77 mha is affected by excess salt (Sheng *et al.*, 2008). Increased salinization of arable land is expected to have devastating global effects, resulting in 30% land loss within the next 25 years and upto 50 % by the year 2050 (Wang *et al.*, 2003).

Salinity is one of the most important stress factor which limits the growth and development of plants by altering their morpho-physiological and

biochemical attributes (Mudgal *et al.*, 2010). The injurious effect of salinity on plant growth are associated with low osmotic potential of soil solution, nutritional imbalance, specific ion effect or a combination of these factors (Zhu, 2003). Soluble salts at higher concentration in growth medium cause imbalance of nutrients in most plants that harmfully decline plant growth (Turan *et al.*, 2010).

Salinity affects both water absorption and biochemical processes (Parida and Das, 2005) resulting in reduction of plant growth (Shahi and Srivastava, 2016). High salt (NaCl) uptake competes with the uptake of other nutrient ions, such as K⁺, Ca²⁺, N and P resulting in nutritional disorders and eventually, reduced yield and quality (Grattan and Grieve, 1999).

Organic manures are plant and animal wastes that are used as sources of plant nutrients. They release nutrients after their decomposition. Manures are the organic materials derived from animal, human and plant residues which contain plant nutrients in complex organic forms. Moreover, organic materials improve the soil physico-chemical

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properties that accelerate exchange of cations on soil solids and leaching of salts from the root zone (Clark *et al.*, 2007), hence, preventing root from salt injuries. Vermicompost is effective organic fertilizer and biocontrol agent (Simsek - Ersahin, 2011) and is also capable of extending threshold values of salt in rooting medium (Ahmad and Jabeen, 2009).

The investigation was carried out to elucidate the effect of salinity on root, NRA, nitrogen content and productivity of sesame plants and mitigation of salt stress by various types of plant nutrients.

MATERIAL AND METHODS

Experiment laid out in complete randomized block design was conducted during year 2015-2016 in the Department of Botany, D.D.U. Gorakhpur University. Surface sterilized seeds of *Sesamum indicum* L. (Cv. T-13) were soaked overnight in water and were germinated in growth chamber under controlled conditions (temp. $25 \pm 2^\circ\text{C}$). Five days old plantlets were transplanted to earthenware pots containing five kg sterilized sand. Level of sand salinity was 0 Mm. Hoagland's nutrient solution was supplied to the plants at seven day interval. Plants were treated with different concentration (100 mM, 150 mM and 200 mM) of NaCl alone and also in combination with different types (12:24:12 NPK 3.0 g, farmyard manure (FYM) 6.0 g, vermicompost 6.0 g) of fertilizers which were applied to salt treated plants at 25 days, 55 days and 85 days after sowing. Untreated plants were kept as Control.

The collection of samples was completed at every ten days interval and various parameters such as root length, root biomass, nitrate reductase enzyme activity (NRA), total nitrogen content was analyzed from Day 30 upto Day 70 at ten days interval. NRA was estimated by the method of Streeter and Bosler (1972) and total nitrogen content was measured by method given by Doneen (1932). Yield was studied in terms of number of capsule per plant and number of seeds per capsule at 80 days of plant growth.

Two-way ANOVA was computed and LSD (Least Significant Difference) was calculated where F test was found significant. SD values have been calculated in case of yield parameters.

RESULTS AND DISCUSSION

The root length and root biomass of *Sesamum indicum* decreased with increase in NaCl concentration. However, when treated with various sources of plant nutrients through NPK, FYM and vermi-compost under salinity these parameters increased (Fig.1 and Fig.2, respectively). Maximum root length and root biomass was recorded with vermicompost treated plants. The result is in agreement as reported by Kapoor and Pandey (2015) on fenugreek and Husen *et al.* (2016) whose experiments were on pea plants. The decrease in root growth may be due to the ability of salinity to effect external water potential, ion toxicity or imbalance (Hasegawa *et al.*, 2000). Vermicompost promotes biological activity, which provides better root environment. Increase in root growth in vermicompost treated plants may be due to presence of auxin in vermicompost which promote root growth by promoting cell division and cell elongation. Several studies reported that the humic acid stimulates root growth in plants (Canellas *et al.*, 2012).

Nitrate reductase activity (NRA) decreased with increase in NaCl concentration. Decrease in nitrate reductase enzyme may be due to decrease in NO_3^- uptake (Iqbal *et al.*, 2002). Bybordi and Ebrahimian (2011) reported that excessive Cl^- in rooting medium inhibits the NO_3^- uptake which is a cause of reduction in Nitrate reductase activity. Salt stress may inhibit enzyme induction which is responsible for decrease in NRA. However, maximum nitrate reductase activity was found in vermicompost treated plants at 100 mM NaCl (Fig.3). The results are parallel to those observed by Shahi and Srivastava (2018) who recorded a prominent decrease in NRA under the influence of high salinity in green gram.

Jabeen and Ahmad (2016) also supported the results and found that vermicompost improved NRA in sunflower under saline and non-saline condition. Compost application results in higher activities of nitrate reductase in *Solanum lycopersicum* (Tartoura *et al.*, 2014). The induction of nitrate reductase in plants treated with organic manure may be due to presence of humic substances. Zandonadi *et al.* (2013) found that humic substances enhance the uptake of nitrate and is stimulus for nitrate reductase activity.

Nitrogen content decreased with increase in NaCl concentration (Fig.4). This may be due to Cl⁻ which inhibits NO₃⁻ uptake (Halperin *et al.*, 2003). Srivastava and Shahi (2017) reported that NaCl salinity reduces nitrogen content in wheat leaves. Kumar *et al.* (2018) also reported a significant decrease in nitrogen content upon salt treatment in chickpea cultivars. Nitrogen content increased in

plants when treated with different organic and inorganic nutrients. This may be due to presence of N, P, K and organic manure containing humic acid. Similarly, Jasim *et al.* (2015) observed humic acid increases nitrogen content under saline condition.

Yield attributes decreased in terms of number of capsules/plant, number of seeds/capsule with increase in salinity (Table 1). The result is similar to the finding of Srivastava and Shahi (2018) who reported that salinity significantly reduced yield in wheat cultivars. However, application of NPK fertilizer, FYM and vermicompost increased the yield of *Sesamum indicum* (L.) under salinity. Maximum number of capsules per plant and number of seeds per capsule were observed in vermicompost treated plants at 100 mM NaCl concentration. The result is in accordance with the finding of Aracnon *et al.* (2004) who reported a positive effect of vermicompost on strawberries yield. Similarly, Haghghi *et al.* (2012)

Table 1. Yield attributes of Sesame under different NaCl concentrations alone and in combination with organic and inorganic fertilizers

Treatments	Number of capsule/plant	Number of seeds/capsule
Control	26 ± 3.60*	64 ± 7.21*
100 mM NaCl	24 ± 5.00	59 ± 6.55
150 mM NaCl	18 ± 6.08	52 ± 6.00
200 mM NaCl	12 ± 3.00	48 ± 2.64
100 mM NaCl + NPK	32 ± 2.00	70 ± 5.56
100 mM NaCl + FYM	41 ± 4.34	75 ± 5.00
100 mM NaCl + VC	50 ± 5.29	82 ± 4.00
150 mM NaCl + NPK	22 ± 5.19	67 ± 4.35
150 mM NaCl + FYM	30 ± 3.60	70 ± 3.10
150 mM NaCl + VC	35 ± 2.64	74 ± 3.00
200 mM NaCl + NPK	17 ± 4.58	57 ± 5.00
200 mM NaCl + FYM	20 ± 4.00	60 ± 4.58
200 mM NaCl + VC	29 ± 3.61	66 ± 7.93

*Mean ± Standard deviation(n=3) ; VC- Vermi Compost; FYM- Farm Yard Manure

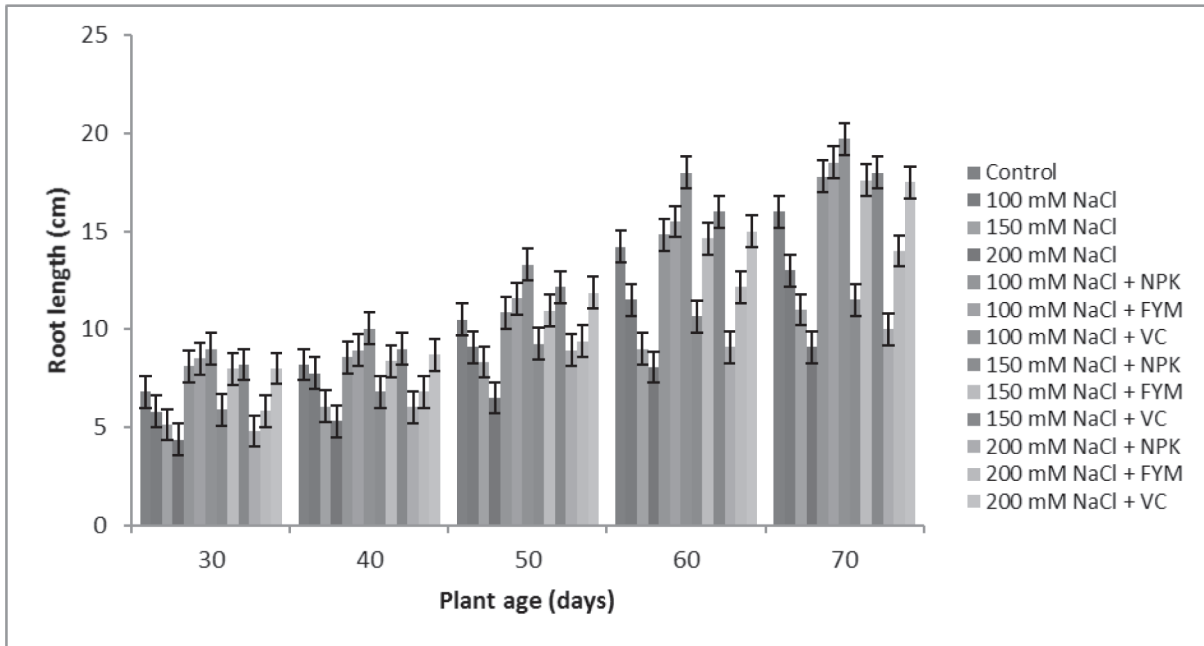


Fig. 1. Root length of Sesame plants under different NaCl concentrations alone and in combination with different organic and inorganic fertilizers

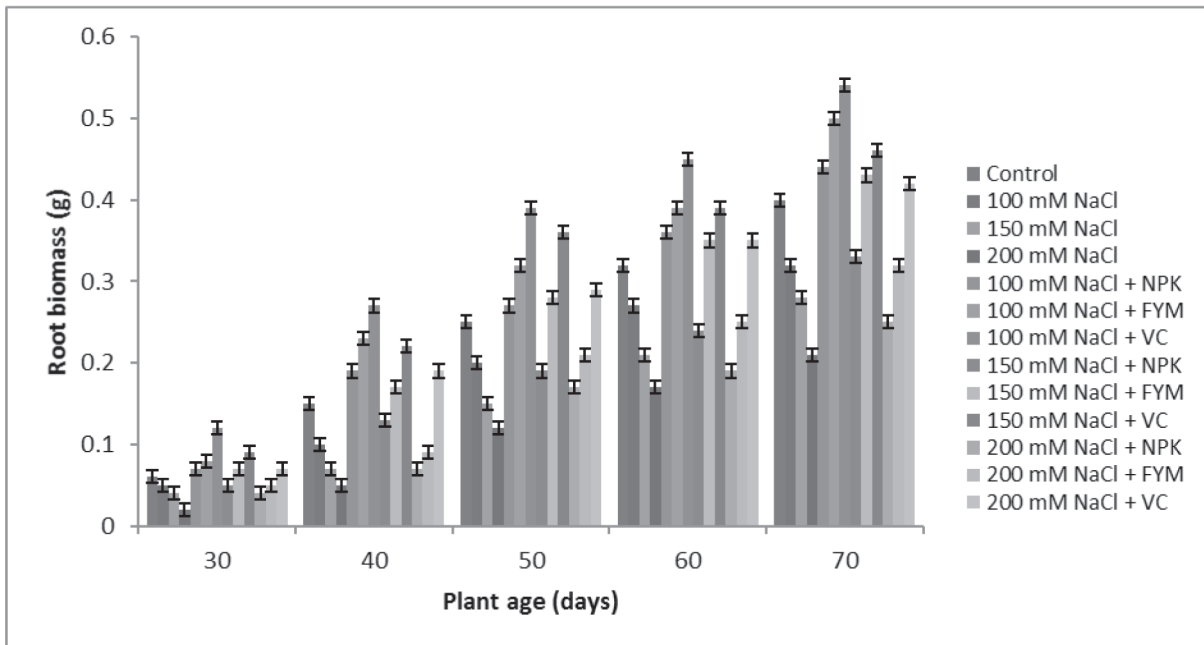


Fig. 2. Root biomass of Sesame under different NaCl concentrations alone and in combination with different organic and inorganic fertilizers

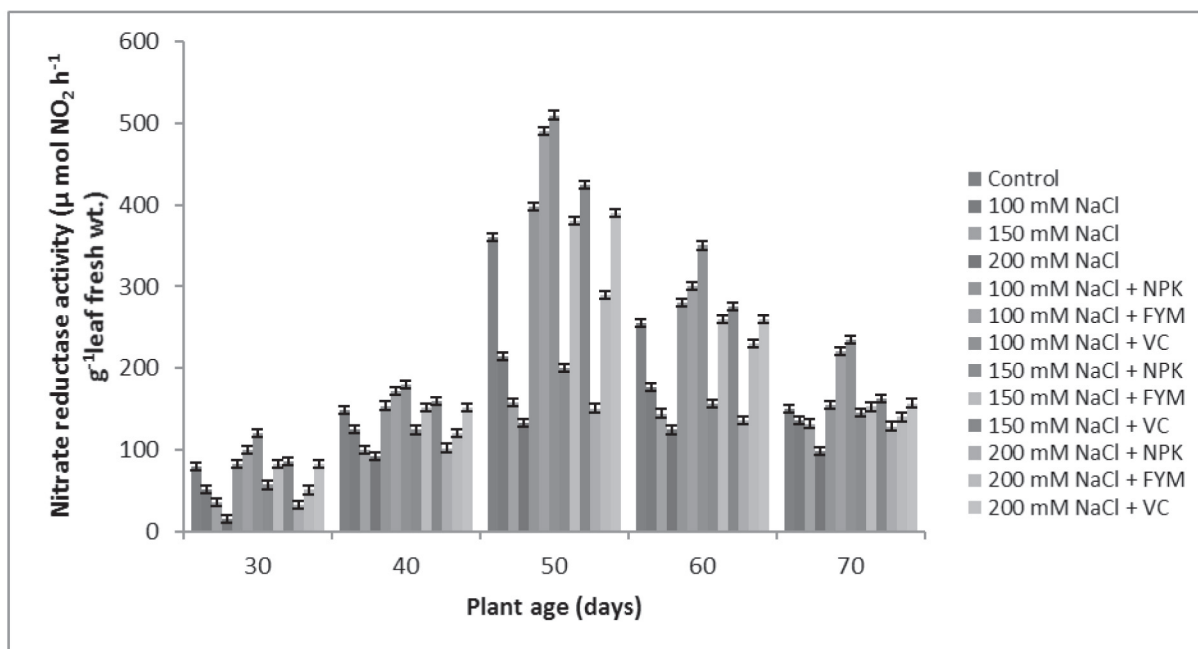


Fig. 3. Nitrate Reductase Activity in Sesame leaves under different NaCl concentrations alone and in combination with different organic and inorganic fertilizers

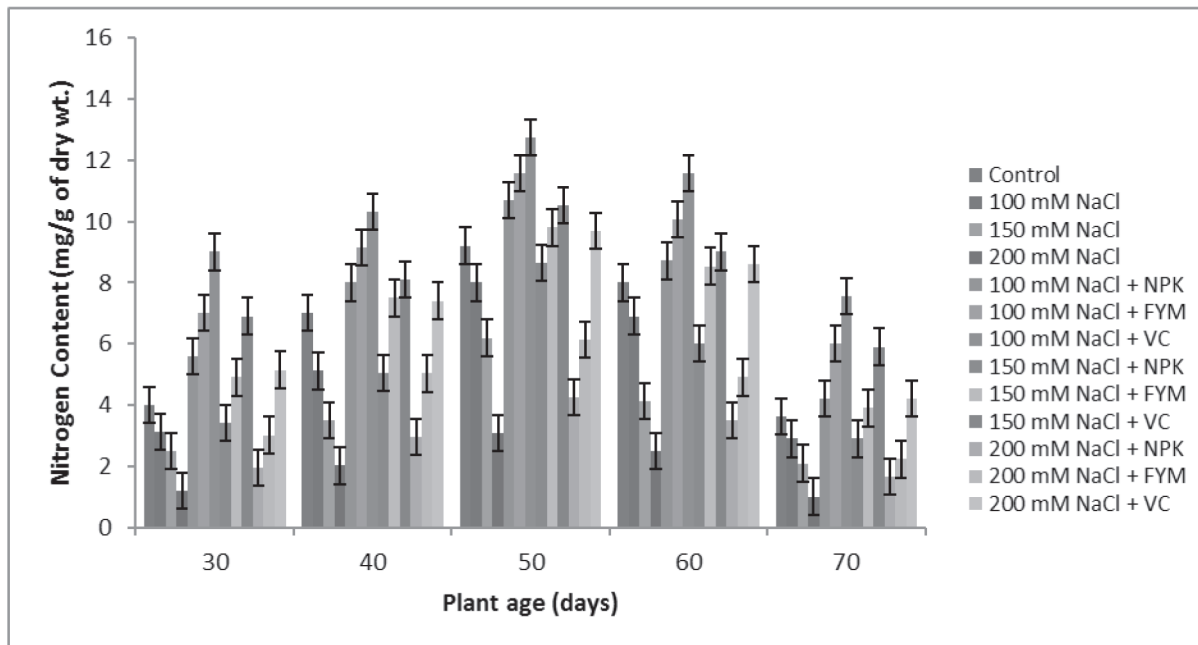


Fig. 4. Nitrogen content of Sesame plants under different NaCl concentration alone and in combination with different organic and inorganic fertilizers

also found that humic acid enhances lettuce yield by stimulating N- metabolism and photosynthetic activity. FYM contains humic acid, fulvic acid and humin. The increase in yield attributes might be due to the presence of growth hormones in organic manures which might have increased number of flowers.

CONCLUSION

Salt stress has detrimental effects on root length, root biomass, NRA, nitrogen content of plant which ultimately led to decline of yield in sesame. Application of various sources of plant nutrients *i.e.*, NPK fertilizer (inorganic), farmyard manure and vermicompost (organic) ameliorates the adversities caused by salt stress. However, organic nutrients showed better response than inorganic fertilizer and the alleviation was more pronounced in vermicompost treated plants. Vermicompost improved the root length, root biomass and NRA in leaves and increased amount of nitrogen uptake thus recorded higher productivity at a higher level of salinity. Hence, the study demonstrates that exogenous application of organic fertilizers can be helpful in ameliorating the adverse impacts of salinity on all the parameters compared to inorganic fertilizers as well as control.

ACKNOWLEDGEMENT

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DIFFERENTIAL REACTION OF SELECTED RESTORERS/MAINTAINERS WITH WA BASED CMS LINES IN HYBRID RICE (*Oryza sativa* L.)

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ABSTRACT

Investigation was carried out to identify restorers/maintainers with wild abortive (WA) based CMS lines. Various inbred lines behaved differently in three CMS back grounds in respect of their maintainer/restorer reaction. Among the 120 hybrids studied, 43 hybrids exhibited very high spikelet fertility (>80%), 49 hybrids exhibited partial fertility (60 to 80%), 23 hybrids showed low fertility (10 to 60%) and five hybrids showed complete sterility/very low fertility (<10%). Nine male parents viz., NLR 145, MTU1001, NLR 34449, WGL 283, Sumati, BPT 5204, WGL 3962, NLR 3041 and PS 5 were found to be potential fertility restorers when crossed with all three CMS lines viz., IR 58025 A, IR 68888A and IR 68897A.

INTRODUCTION

Rice occupies a premier place in Indian agriculture and plays a major role in Indian economy, being the staple food of two-third of the population. More than 90% of the world's rice is grown and consumed in Asia, wherein, 60% of the global populations live (Khush, 2005). The population in rice consuming countries continues to grow steadily and it is estimated that 40% more have to be produced by 2030. To meet the increasing demand for rice, several measures have to be envisaged. Therefore, rapid increase in production and productivity of rice is the need of hour as per the growing population. Hence, different strategies are to be worked out in order to bridge the gap between demand and supply. One such strategy would be the improvement of high yielding genotypes through hybridization. Hybrid rice is the best practically feasible and readily acceptable options available to increase the production. For the development of rice hybrids through cytoplasmic male sterility and fertility restoration system, identification of stable maintainers and restorers from the local elite lines is utmost important. The objective of the study was to identify better male and female parents for the development of good rice hybrids.

Therefore, an attempt was made to identify the better maintainers and restorers of CMS based in hybrid rice breeding.

MATERIAL AND METHODS

Three cytoplasmic male sterile (CMS) lines of WA source obtained from Indian Institute of Rice Research (ICAR-IIRR), Hyderabad and forty elite diverse lines comprised the basic material. The three CMS lines were crossed with 40 male fertile medium duration lines in a Line x Tester (L x T) mating design to obtain 120 F₁ hybrids during *Kharif*, 2014 at Agricultural Research Station, Nellore. Sum of 120 F₁ hybrids were transplanted in randomized block design in two replications with a spacing of 20 cm x 15 cm, number of rows 4 and row length 4.5 m during *Kharif*, 2015 to study the differential reaction of selected restorers/maintainers with wild abortive (WA) based CMS lines. The matured panicles from 120 F₁ hybrids were harvested and ratio of fertile spikelet's to the total number of spikelet's was expressed as percentage (spikelet fertility per cent). Based on the per cent spikelet fertility in F₁ hybrids, male parents were classified as potential restorers >80 % fertility, partial restorers 60% - 80 % fertility, partial

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maintainers 10% - 60% fertility and maintainers <10 % fertility (Virmani *et al.*, 1997).

RESULTS AND DISCUSSION

A total of 120 crosses, involving three CMS lines and 40 male parents were evaluated for spikelet fertility during *Kharif*, 2015. The performance of the test cross hybrids and the grouping of testers based on spikelet fertility reaction were presented in Table 1 and Table 2. The differential ability to restore fertility in CMS lines that have WA cytotsterile system could result from different nuclear background of the CMS lines. The varied performance of restorers with CMS line, season of testing was also reported by Salgotra *et al.* (2002) and Malarvizhi *et al.* (2003). Differential response of the genotypes to the CMS lines of the same WA cytotsterility source may also be due to the interaction between the nuclear / remnant genes of the maintainer lines with the genes of male parents.

Spikelet fertility among the hybrids in *Kharif*, 2015 ranged from 1.44 (IR-58025A x NLR 3042) to 93.17 per cent (IR-58025A x NLR5 145). Among 120 hybrids studied in *Kharif*, 2015, forty-three crosses exhibited very high spikelet fertility (>80%), 49 crosses exhibited partial fertility (60 to 80%), 23 crosses showed low fertility (10% to 60%) and five crosses showed complete sterility/very low fertility (<10%) (Fig.1). Similar results were also reported by Upadhyay and Jaiswal (2012), Bhadru *et al.*(2015), Rajendra Prasad *et al.*(2017), Shama *et al.*(2018) in their studies while using different elite lines.

For the CMS line IR 58025 A, pollen parents *viz.*, NLR 145, MTU1001, NLR 34449, WGL 283, JGL 11118, Sumati, BPT 5204, WGL 3962, NLR 3041 and Pusa Sugandha (PS) 5 were identified as potential fertility restorers as they recorded more than 80 per cent spikelet fertility. Pollen parents *viz.*, ADT 37, NLR 3083, WGL 32100, RNR 2458, NLR 3010, NLR 40058, NLR 40024, BPT 2411, WGL 14, WGL 23985, MTU 1010, NLR 33671, ADT 45, JGL 1798, Pusa Sugandha (PS) 4, NLR 34303, NLR 33359, CR 1009, HMT Sona and IR 36 were identified

as partial restorers by recording fertility restoration between 60% to 80%. Male parents *viz.*, Vasumati, Kasturi, RNR 2465, ADT 43, NLR 40065, NLR 33057, RNR 2354, NLR 33358 and WGL 44 were identified as potential maintainers as they showed less than 60 per cent spikelet fertility (Fig. 2). Similar results were also reported by Rosamma and Vijayakumar (2005), Parmita and Ashish (2017) and Shama *et al.* (2018) in their studies using IR 58025 A line.

Pollen parents *viz.*, NLR 40024, NLR 3083, MTU1001, NLR 145, ADT 37, NLR 34449, WGL 3962, WGL 32100, Sumati, MTU 1010, WGL 283, RNR 2458, BPT 5204, PS 4 and NLR 3041 were found to be potential restorers for IR-68888A, while, NLR 3010, PS 5, NLR 40058, NLR 40065, ADT 43, JGL 11118, WGL 23985, WGL 44, CR 1009, WGL 14, NLR 34303, NLR 33057, ADT 45, NLR 33359 and NLR 3042 were the partial restorers. Male parents *viz.*, BPT 2411, IR 36, RNR 2465, HMT Sona, Kasturi and Vasumati were identified as partial maintainers as they showed less than 60 per cent spikelet fertility (Fig. 3).

Out of 40 male parents crossed with IR 68897A, eighteen male parents *viz.*, MTU 1001, NLR 3083, PS 4, MTU 1010, WGL 283, JGL 11118, Sumati, NLR 3041, ADT 37, BPT 5204, WGL 32100, NLR 34449, WGL 3962, NLR 3010, RNR 2458, NLR 145, PS 5 and NLR 40024 were proved potential fertility restorers. While, CR 1009, NLR 33359, WGL 14, NLR 33671, ADT 45, WGL 23985, RNR 2465, IR 36, JGL 1798, NLR 34303, ADT 43, NLR 40058, BPT 2411 and RNR 2354 were shown to be partial restorers. Male parents *viz.*, NLR 40065, HMT Sona, WGL 44, NLR 3042, NLR 33057, Vasumati, NLR 33358 and Kasturi were identified as partial maintainers (Fig. 4).

CONCLUSION

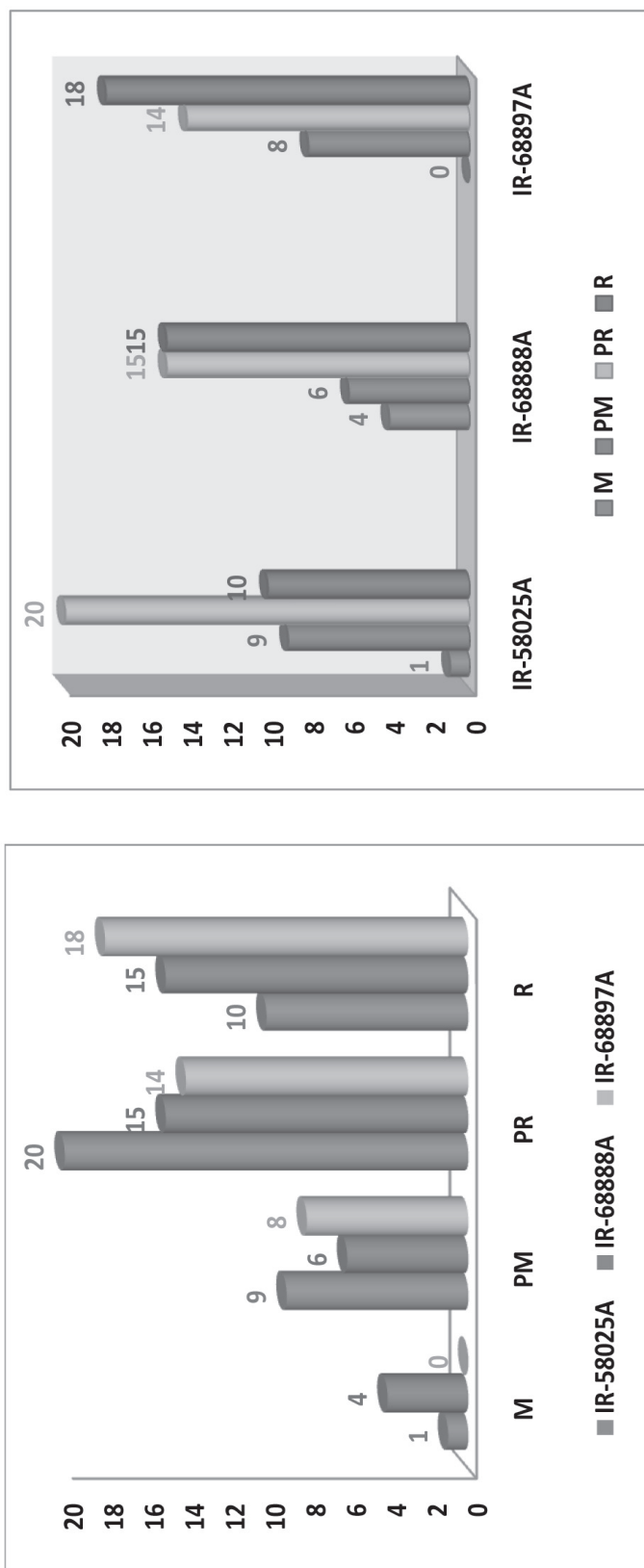
Among the 40 male lines studied, nine male parents *viz.*, NLR 145, MTU1001, NLR 34449, WGL 283, Sumati, BPT 5204, WGL 3962, NLR 3041 and PS 5 were found to be potential fertility restorers

DIFFERENTIAL REACTION OF SELECTED RESTORERS/MAINTAINERS IN HYBRID RICE

Table 1. Estimates of mean per cent spikelet fertility among rice hybrids during *Kharif*, 2015

S. No.	Genotype	IR-58025A		IR-68888A		IR-68897A	
		Spikelet fertility (%)	Fertility reaction	Spikelet fertility (%)	Fertility reaction	Spikelet fertility (%)	Fertility reaction
1	NLR 145 (Swarnamukhi)	93.17	R	84.96	R	83.22	R
2	NLR 34449 (Nellore Mahsuri)	88.59	R	83.55	R	85.10	R
3	NLR 33358 (Somasila)	12.29	PM	5.51	M	23.07	PM
4	NLR 33057 (Swathi)	35.49	PM	71.62	PR	26.84	PM
5	NLR 40024 (Swetha)	74.20	PR	87.43	R	81.52	R
6	NLR 3041 (Nellore Sona)	81.67	R	80.20	R	87.48	R
7	NLR 3042	1.44	M	64.35	PR	31.78	PM
8	NLR 3010	74.71	PR	78.45	PR	84.15	R
9	NLR 40065	37.67	PM	74.79	PR	52.97	PM
10	NLR 40058	74.35	PR	74.90	PR	66.78	PR
11	NLR 3083	78.51	PR	85.59	R	91.01	R
12	ADT 37	78.86	PR	84.29	R	87.18	R
13	ADT 43	40.14	PM	74.45	PR	66.89	PR
14	JGL 11118 (Anjana)	85.59	R	73.81	PR	88.12	R
15	JGL 1798 (Jagitial Sannalu)	71.94	PR	2.70	M	67.81	PR
16	MTU 1010 (Cotton dora Sannalu)	73.33	PR	82.38	R	88.83	R
17	MTU1001 (Vijetha)	90.24	R	85.34	R	91.65	R
18	IR 36	62.18	PR	43.32	PM	68.39	PR
19	NLR 33671	72.83	PR	3.52	M	70.72	PR
20	RNR 2465 (Sugandha samba)	49.04	PM	41.31	PM	68.93	PR
21	RNR 2458 (Krishna)	77.33	PR	81.77	R	84.09	R
22	ADT 45	72.64	PR	70.51	PR	70.66	PR
23	NLR 34303	71.35	PR	72.40	PR	67.15	PR
24	Pusa Sugandha(PS) 4	71.36	PR	81.01	R	89.35	R
25	Pusa Sugandha(PS) 5	80.62	R	78.00	PR	83.03	R
26	HMT Sona	62.59	PR	40.93	PM	52.01	PM
27	BPT 5204 (Sambamahsuri)	83.04	R	81.08	R	86.87	R
28	WGL 44 (Siddhi)	11.93	PM	73.52	PR	45.82	PM
29	Kasturi	50.50	PM	29.97	PM	16.67	PM
30	RNR 2354(Shobini)	12.68	PM	3.32	M	64.26	PR
31	WGL 14 (Warangal Samba)	73.27	PR	72.99	PR	72.30	PR
32	WGL 23985 (Ramappa)	73.26	PR	73.79	PR	69.91	PR
33	CR 1009(Savithri)	65.22	PR	73.06	PR	73.83	PR
34	Vasumati	57.57	PM	10.55	PM	26.64	PM
35	Sumati	85.38	R	82.39	R	87.68	R
36	NLR 33359 (Sravani)	68.54	PR	68.45	PR	72.98	PR
37	WGL 32100 (Warangal Sannalu)	77.83	PR	83.36	R	86.49	R
38	WGL 283 (Sheethal)	87.49	R	82.21	R	88.20	R
39	WGL 3962	82.04	R	83.44	R	84.82	R
40	BPT 2411	73.45	PR	52.22	PM	65.39	PR

M : Maintainers ; **PM** : Partial Maintainers; **PR** : Partial Restorers;**R** : Restorers

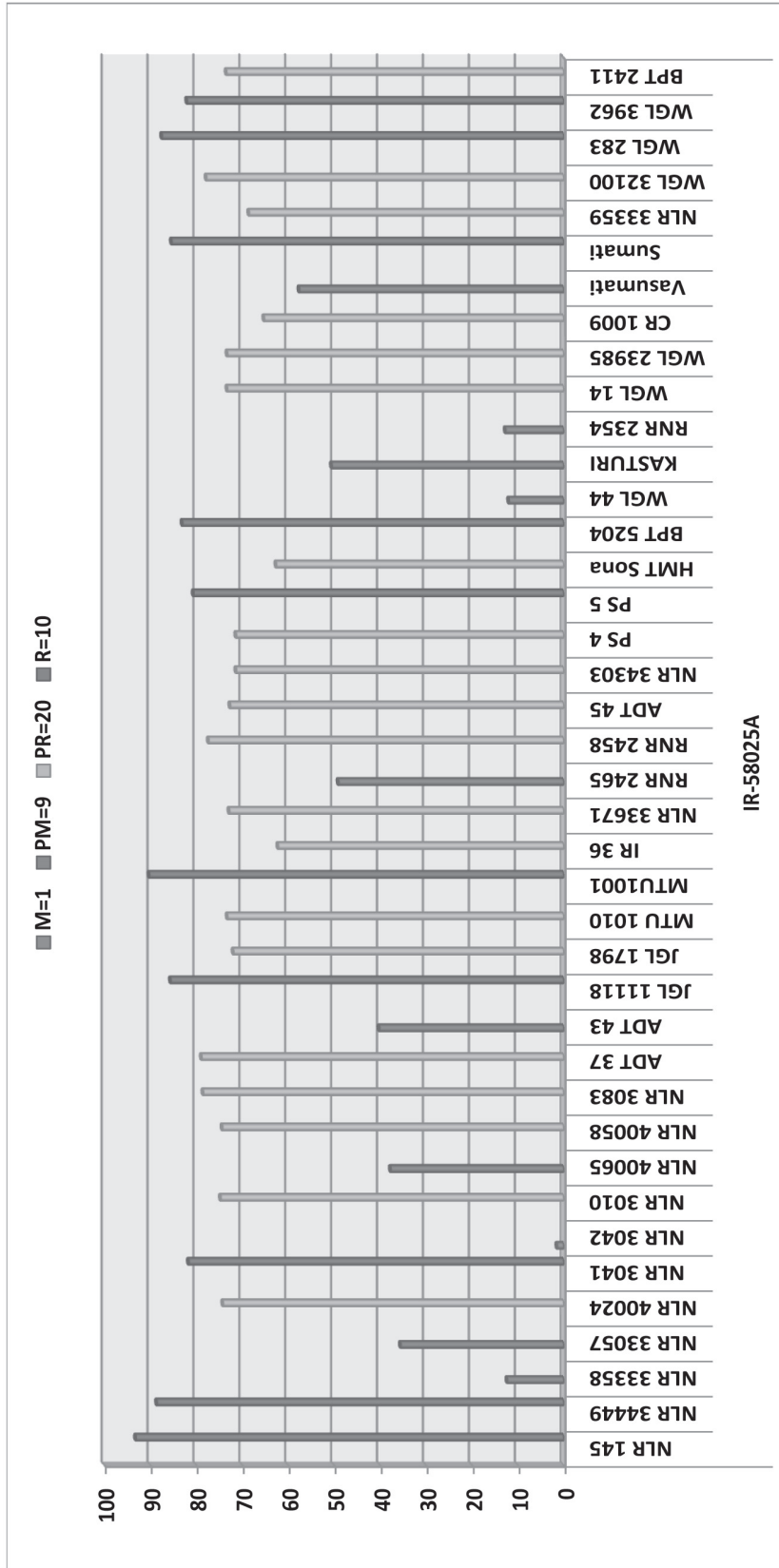


M: Maintainers; PM : Partial Maintainers; PR : Partial Restorers; R : Restorers

Fig. 1. Identified potential restorers and maintainers on IR 58025 A, IR 68888 A and IR 68897 A based on spikelet fertility reaction

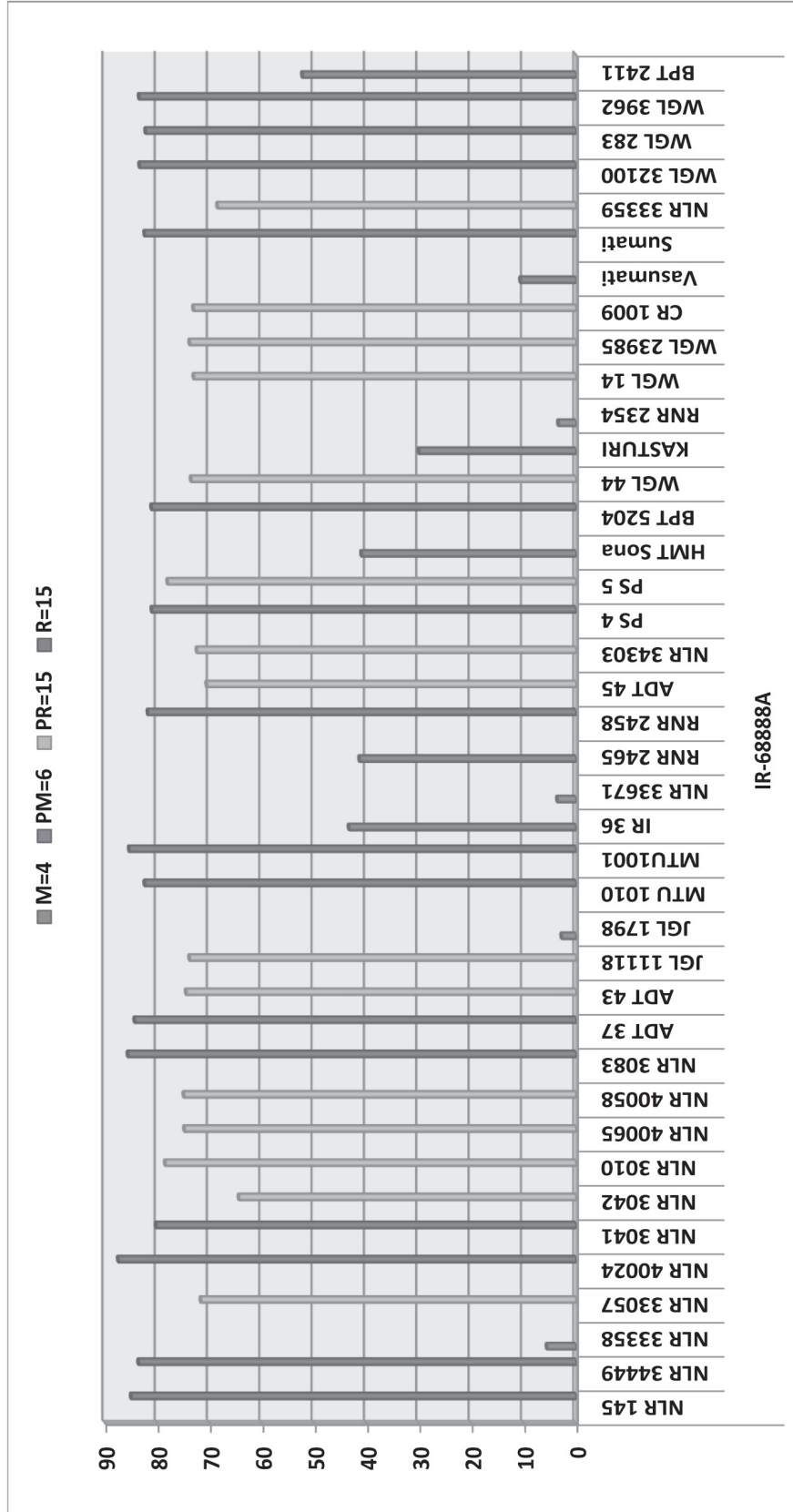
Table 2. Grouping of male parents based on their reaction into as maintainers and restorers

CMS line	Maintainers	Partial Maintainers	Partial Restorers	Restorers
IR-58025A	NLR 3042	WGL 44, NLR 33358 RNR 2354, NLR 33057, NLR 40065, ADT 43, RNR 2465, Kasturi, Vasumati	IR 36, HMT SonaCR 1009, NLR 33359, NLR 34303, PS 4, JGL 1798, ADT 45, NLR 33671, MTU 1010, WGL 23985, WGL 14, BPT 2411, NLR 40024, NLR 40058, NLR 3010, RNR 2458, WGL 32100, NLR 3083ADT 37	PS 5, NLR 3041, WGL 3962, BPT 5204, Sumati, JGL 1118, WGL 283, NLR 34449, MTU1001, NLR 145
IR-68888A	JGL 1798 RNR 2354 NLR 33671 NLR 33358	Vasumati, Kasturi HMT Sona, RNR 2465, IR 36, BPT 2411	NLR 3042, NLR 33359, ADT 45, NLR 33057, NLR 34303, WGL 14, CR 1009, WGL 44 WGL 23985, JGL 1118, ADT 43, NLR 40065, NLR 40058, PS 5, NLR 3010	NLR 3041, PS 4, BPT 5204, RNR 2458, WGL 283, MTU 1010, Sumati, WGL 32100, WGL 3962, NLR 34449, ADT 37, NLR 145, MTU1001, NLR 3083, NLR 40024
IR-68897A		Kasturi, NLR 33358, Vasumati, NLR 33057 NLR 3042, WGL 44 HMT Sona, NLR 40065	RNR 2354, BPT 2411, NLR 40058, ADT 43, NLR 34303, JGL 1798, IR 36, RNR 2465, WGL 23985, ADT 45, NLR 33671, WGL 14, NLR 33359, CR 1009	NLR 40024, PS 5, NLR 145, RNR 2458, NLR 3010, WGL 3962, NLR 34449, WGL 32100, BPT 5204, ADT 37, NLR 3041, Sumati, JGL 1118, WGL 283, MTU 1010, PS 4, NLR 3083, MTU1001



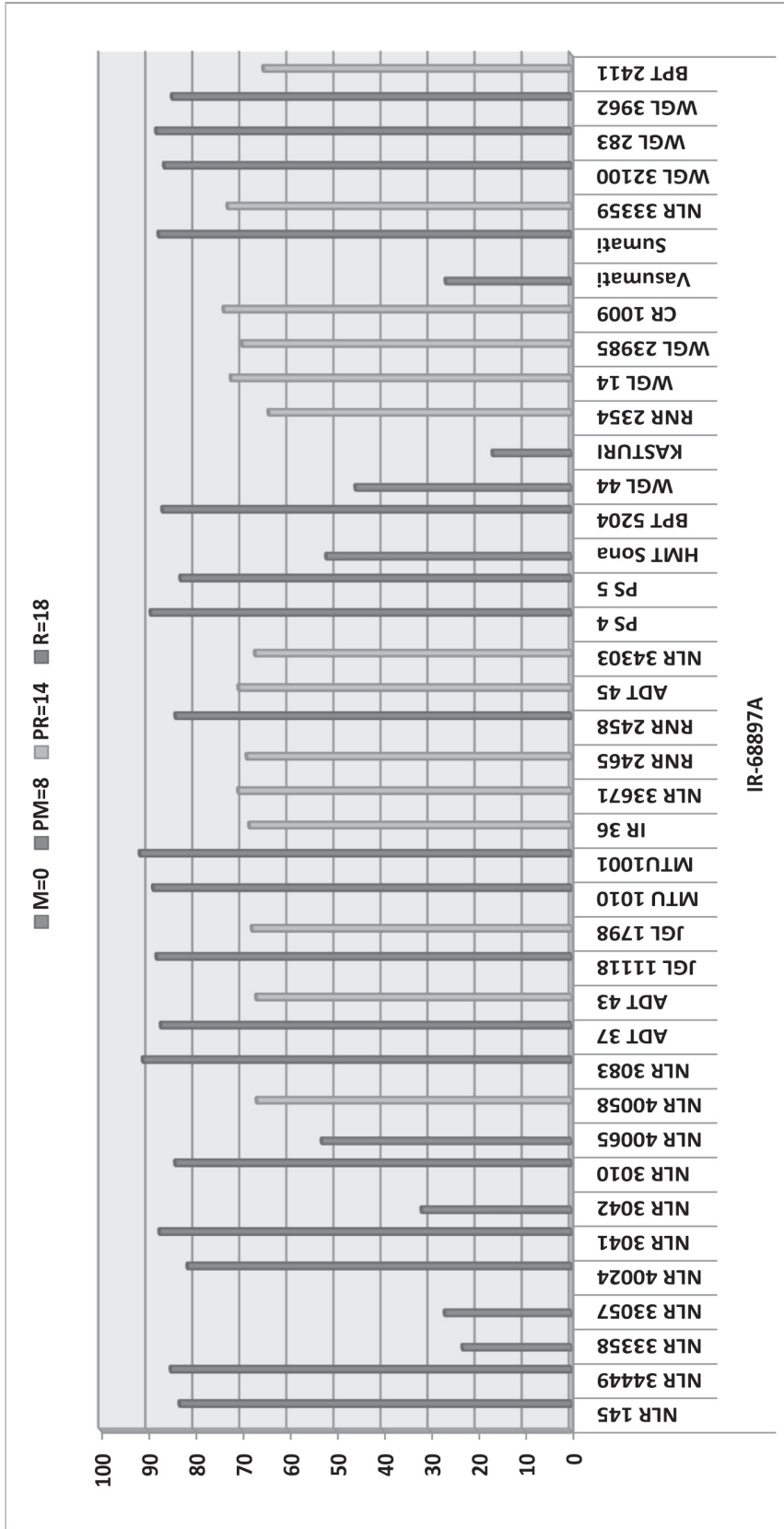
M : Maintainers; PM : Partial Maintainers ; PR : Partial Restorers ; R : Restorers

Fig. 2. Identified potential restorers and maintainers in IR 58025 A based on spikelet fertility reaction



M : Maintainers; PM : Partial Maintainers; PR : Partial Restorers; R : Restorers

Fig. 3. Identified potential restorers and maintainers in IR 68888 A based on spikelet fertility reaction



M : Maintainers; PM : Partial Maintainers; PR : Partial Restorers; R : Restorers

Fig. 4. Identified potential restorers and maintainers in IR 68897 A based on spikelet fertility reaction

when crossed with all three CMS lines viz., IR 58025A, IR 68888A and IR 68897A. Six male parents NLR 40024, NLR 3083, ADT 37, WGL 32100, MTU 1010 and RNR 2458 were found to be potential fertility restorers when crossed with two CMS lines viz., IR 68888A and IR 68897A and two male parents viz., PS 4 and NLR 3010 were found to be potential fertility restorers when crossed with one CMS line IR 68897A. One male parent JGL 11118 was found to be potential fertility restorer when crossed with two CMS lines viz., IR 58025 A and IR 68897A. The identified restorer lines can be used as pollen parent in developing new commercial hybrids. New restorer may also be developed through crossing programme which can expand the genetic base of restorer by pyramiding complementary traits from diverse sources according to breeding objectives.

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EFFECT OF INTEGRATED USE OF CHEMICAL FERTILIZERS, ORGANIC MANURES AND BIOFERTILIZERS ON SOIL PROPERTIES AND YIELD OF MAIZE

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ABSTRACT

The experiment aimed to study the effect of integrated use of chemical fertilizers, organic manures and biofertilizers on soil properties and yield of maize was carried out during kharif, 2017 was laid out in a randomized block design with eight treatments and replicated thrice. Highest grain yield (5827 kg ha^{-1}), straw yield (6026 kg ha^{-1}) and harvest index (0.49) were observed in the treatment applied with 100 % recommended dose of nitrogen. Highest post-harvest soil, available nitrogen (170 kg ha^{-1}) was recorded with 100% recommended dose of nitrogen, whereas highest available phosphorous and potassium were recorded in treatment applied with 50% RDN + 50% N through FYM. Similarly, highest urease and dehydrogenase activity, was recorded in the soil at knee high, tasseling and harvest stages with in the treatment of 50% RDN + 50% N supplied through FYM.

INTRODUCTION

Maize (*Zea mays* L) is one of the most versatile re-emerging crops having wider adaptability under varied agro-climatic conditions and successful cultivation in diverse seasons and ecologies for various purposes. It has become an important raw material in food processing, poultry, dairy, meat and ethanol industry, besides, its traditional uses makes it one of the fastest growing cash crops in the world. Maize has a greater nutritional value (Has *et al.*, 2009) and harvests the nutrients heavily from the soil. Hence, yield of maize is alarmingly affected by the deficiency of nutrients (especially N). Maize needs ample quantity of N for its better production. It is, therefore, imperative to use an optimum amount of N through a suitable and efficient nitrogen sources because it plays a very significant role in crop development (Ahmad, 2000).

The soils being low in Nitrogen (N) require application of this nutrient in appropriate and balanced amount. In spite of substantial fertilizer use, the crop yields are not increasing correspondingly, which reflect low Fertilizer Use Efficiency (FUE). Further, continuous use of fertilizers creates potential polluting effect on the environment (Oad *et al.*, 2004). Under the present trend of exploitative agriculture in

India, inherent soil fertility can no longer be maintained on sustainable basis. It is evidently said that nutrient supplying capacity of soil declines steadily under continuous and intensive cropping.

The integration of organic sources with synthetic sources of nutrients not only supply essential nutrients, but also have some positive interaction with chemical fertilizers to increase their efficiency and thereby, reduce environmental hazards. Keeping these in view, the experiment was conducted to study the effect of different levels of nitrogen, vermicompost, FYM and biofertilizers on soil properties and yield of maize and to find out the possible combinations of inorganic and organic sources for supply of the nutrients.

MATERIAL AND METHODS

The field experiment was carried out in sandy loam soils at Agricultural College Farm, Bapatla, Andhra Pradesh during *Kharif*, 2017. The experimental soil was slightly acidic in reaction (pH: 6.7) and non-saline (EC: 0.27 dS m^{-1}) in nature with low Organic Carbon (0.25%). The soil available nutrient status (N, P and K) at the beginning of the experiment was 150 kg ha^{-1} , 54.3 kg ha^{-1} and 268 kg ha^{-1} .

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ha⁻¹, respectively. The experiment was designed with eight (8) treatments replicated thrice in randomized block design. The treatments consisted of T₁: Absolute control (No fertilizer); T₂: Recommended Dose of Nitrogen; T₃: RDN 50% through urea + 50% N through vermicompost T₄: RDN 50% through urea + 50% N through FYM T₅: 50% RDN through urea + Azospirillum @ 5 kg ha⁻¹ T₆: 75% RDN through urea + 25% N through vermicompost T₇: 75% RDN through urea + 25% N through FYM T₈: 75% RDN through urea + Azospirillum @ 2.5 kg ha⁻¹. Maize crop (variety Pioneer 3396) was used as a test crop. Among the organic sources, FYM was applied one week prior to sowing, whereas, vermicompost was applied two days before sowing and was applied one day before sowing. Recommended dose of N, P₂O₅ and K₂O kg ha⁻¹ were applied in the form of urea (in three equal splits), single super phosphate (basal) and muriate of potash (basal), respectively. The seeds were dibbled at a spacing of 60 cm x 20cm. The soil samples were collected at harvest and estimated for available macronutrients (NPK) and micronutrients (Fe, Cu, Mn and Zn) by employing suitable methods. Data interpretation was completed by employing suitable statistical method.

RESULTS AND DISCUSSION

Grain Yield

The grain yield increased significantly with increase in the levels of nitrogen, organic sources and biofertilizers (Table 1). Highest grain yield (5827 kg ha⁻¹) was recorded in T₂ (RDN 100% through urea), which was on par with treatments of 75% RDN + 25% N through vermicompost (T6) and 75% RDN + 25% N through FYM (T7). Treatments supplied with recommended doses of nitrogen through inorganic fertilizer (T2) were significantly superior to those which received the nitrogen through organic or biofertilizers applied in combination with inorganics.

Soil Physico-Chemical Properties

The soil pH, Electrical Conductivity (EC) and Organic Carbon (OC) at harvest stage of maize crop were not significantly influenced by the application of different treatments (Table 2).

Major and Micro Nutrients

The highest soil available nitrogen was recorded with application of 100% recommended dose of nitrogen at harvest stage (170 kg ha⁻¹) (Table 3). Higher accumulation of available N in all the treatments when compared to control might be due to increase in net N mineralization rates by the application of inorganic as well as organic fertilizers (Sharma *et al.*, 2017). Soil, available phosphorous was highest in T₄ at harvest stage (65.6 kg ha⁻¹) which was on par with T₃, T₅ and T₇ (Table 2). Highest soil available P at harvest in treatment T₃ through T₈ be due to amending soil with organic manures and, biofertilizers that helps in enhancing the P concentration in solution through mineralization of organic P and solubilization of native soil P compounds by producing organic acids. (Roy *et al.*, 2017). Soil available potassium at harvest stage (474 kg ha⁻¹) was also recorded highest in T₄ which was significantly superior over other treatments (Table 2). Highest available potassium in integrated treated plot might be due to the addition of organic matter that reduced potassium fixation and released potassium due to interaction of organic matter with clay, besides the direct addition of potassium to the pool of soil (Urkurkar *et al.*, 2010). However availability of micronutrients (Fe, Cu, Mn and Zn) in post-harvest soil was not significantly influenced by different treatments (Table 2).

Enzyme Activity

Highest urease and dehydrogenase activity was observed at tasseling stage over knee high stage. Highest urease and dehydrogenase activity was recorded as 9.16 $\mu\text{g NH}_4^+ \cdot \text{g}^{-1} \text{soil h}^{-1}$ and 31.47 $\mu\text{g TPF g}^{-1} 24 \text{ h}^{-1}$ respectively at knee high stage and 18.46 $\mu\text{g NH}_4^+ \cdot \text{g}^{-1} \text{soil h}^{-1}$ and 75.79 $\mu\text{g TPF g}^{-1} 24 \text{ h}^{-1}$, respectively at tasseling stage in T₄ (Table 3). Enhancement of urease and dehydrogenase activity with increased rate of nitrogen application along with FYM to soil might be due to added organic manures which acted as sole source of carbon and energy for microbes by which their population increased resulting in increased enzymatic activity (Selvi *et al.*, 2004).

Table 1. Effect of different levels of nitrogen, FYM, vermicompost and biofertilizers on yield (kg ha⁻¹) of maize

Treatments	Grain yield	Stover yield	Harvest index
T ₁	3035	3186	0.48
T ₂	5827	6026	0.49
T ₃	4405	4574	0.49
T ₄	3940	4124	0.48
T ₅	3488	3662	0.48
T ₆	5763	5962	0.49
T ₇	5310	5499	0.49
T ₈	4858	5037	0.49
SEm±	179	197	0.01
CD (5%)	545	600	NS
CV (%)	6.8	7.2	4.5

Table 2. Effect of different levels of nitrogen, FYM, vermicompost and biofertilizers on soil physico-chemical properties and soil available nutrients at harvest of maize crop

Treatments	pH	EC (dSm ⁻¹)	OC (%)	N	P	K	Fe	Cu	Mn	Zn
				(kg ha ⁻¹)			(mg kg ha ⁻¹)			
T ₁	6.7	0.22	0.29	143	50.0	268	6.41	1.56	5.47	0.52
T ₂	6.6	0.18	0.35	170	51.4	347	9.33	1.94	6.71	0.59
T ₃	6.5	0.16	0.32	154	63.4	335	7.73	1.74	6.11	0.54
T ₄	6.3	0.21	0.32	147	65.6	474	7.55	1.74	6.02	0.53
T ₅	6.3	0.19	0.32	146	61.9	427	6.98	1.66	5.92	0.53
T ₆	6.6	0.16	0.35	168	58.9	416	8.07	1.84	6.41	0.58
T ₇	6.4	0.18	0.34	161	60.4	420	7.90	1.81	6.41	0.57
T ₈	6.4	0.14	0.34	161	53.9	416	7.90	1.79	6.31	0.55
SEm±	0.13	0.01	0.01	7.4	2.2	7.0	0.33	0.07	0.22	0.02
CD(5%)	NS	NS	NS	22	6.6	50.0	NS	NS	NS	NS
CV (%)	3.6	10.6	8.3	8.2	6.5	7.2	7.4	7.0	6.4	6.9

Table 3. Effect of different levels of nitrogen, FYM, vermicompost and biofertilizers on soil biological activity at knee high and tasseling stages of maize crop

Treatments	Urease ($\mu\text{g NH}_4^+ \text{ g}^{-1} \text{ soil h}^{-1}$)		Dehydrogenase ($\mu\text{g TPF g}^{-1}24 \text{ h}^{-1}$)	
	Knee high	Tasseling	Knee high	Tasseling
T ₁	5.99	8.20	11.11	45.04
T ₂	6.36	9.32	12.21	51.71
T ₃	8.88	15.76	26.29	71.71
T ₄	9.16	18.46	31.47	75.79
T ₅	8.04	12.86	25.18	69.86
T ₆	6.46	9.60	19.25	59.86
T ₇	7.39	9.88	22.22	61.71
T ₈	7.58	11.84	24.07	68.01
SEm _±	0.27	0.59	1.12	4.50
CD (5%)	0.82	1.80	3.42	13.67
CV (%)	6.3	8.6	9.0	12.4

CONCLUSION

Significant increase in grain yield and available nitrogen content in post-harvest soil was observed with the application of 100% recommended dose of nitrogen kg ha^{-1} whereas, highest available P & K content in post-harvest soil and enzyme activity were recorded with the application of 50% N recommended dose of N through urea and 50% N through FYM.

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EFFECT OF NUTRIENT AND WEED MANAGEMENT ON CRUDE PROTEIN, YIELD AND NUTRIENT UPTAKE IN CHICKPEA (*Cicer arietinum* L.)

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ABSTRACT

The experiment was carried out during *Rabi* seasons of 2013-14 and 2014-15 to study the effect of nutrient and weed management practices on crude protein, yield and nutrient status of chickpea. Application of 125% RDF showed the higher seed yield, nutrient uptake by seed and crude protein yield of seed (302 kg ha⁻¹ and 356 kg ha⁻¹) during 2013-14 and 2014-15, respectively; whereas, 150% RDF showed the higher stover yield and nutrient uptake by stover as well as crude protein yield of stover (106 kg ha⁻¹ and 121 kg ha⁻¹) during 2013-14 and 2014-15, respectively. Among weed management practices, application of Metribuzin 0.4 kg ha⁻¹ + Oxyfluorfen 0.3 kg ha⁻¹ as PE resulted in higher seed and stover yield; nutrient uptake by seed and stover; crude protein yield of seed (397 kg ha⁻¹ and 452 kg ha⁻¹) during 2013-14 and 2014-15, respectively, crude protein yield of stover (125 kg ha⁻¹ and 139 kg ha⁻¹) during 2013-14 and 2014-15, respectively were also high.

INTRODUCTION

Pulses are the important food crop of the world because it provides good source of vegetable dietary protein, mostly in areas where economy does not support large scale production and utilization of animal protein. (Peerzada *et al.*, 2014). Chickpea is one of the best sources of pulse in India. It is an excellent source of vitamins B6, vitamin C and Zinc. In India, its area, production and productivity are 9.54 mha, 9.08 mt and 951 kg ha⁻¹, respectively (Directorate of Economics and Statistics, 2016). In Chhattisgarh state, chickpea is also one of the important pulses and occupies an area of 375.76 thousand ha with production and productivity of 402.06 thousand tonne and 1070 kg ha⁻¹ respectively. Chickpea is a very poor competitor to weeds. Manual weeding is the common practice by farmers. However, now a days there is scarcity of labourers and it is time consuming also. Herbicides control broad spectrum of weed species in pulses effectively. Usage of herbicides in proper way will control weeds during critical period of crop-weed competition. Fertilizers also play significant role in boosting up

the production of pulses. Nitrogen is an essential macronutrient needed by all plants to thrive. Phosphorus and potassium are the nutrients required in large quantity for optimum growth and yield of pulses. Herbicides may change the nutrient status in soil as well as uptake by crop and weeds.

The impact of nutrient doses and herbicides on nutrient status and uptake has not been evaluated by the researchers. Hence, there is need to know the effect of herbicides and nutrient doses on nutrient status and uptake. In the light of the above, the field experiment was carried out to find out suitable herbicide and economical nutrient dose for chick pea.

MATERIAL AND METHODS

The experiment was carried out during *Rabi* seasons of 2013-14 and 2014-15 at the Research Farm, Indira Gandhi *Krishi Vishwavidyalaya*, Raipur located between 21°4' N latitude and 81°39' E longitude with an altitude of 298m above MSL having sub-tropical humid climate. The experimental soil was clayey (vertisol) with pH 7.12, EC 0.20 m mhos m⁻¹, low in available nitrogen (213 kg N ha⁻¹), medium in available

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phosphorus (12.5 kg P ha⁻¹), high in available potassium (300 kg K ha⁻¹) and organic carbon (0.48 %). The experiment was laid out in split plot design

with three replications and with a plot size of 4.8 m x 4.0 m. Variety 'JG-226' was sown.

Treatments

Main plot (Nutrient management)

1. Recommended Dose of Fertilizers (20 kg N, 50 kg P₂O₅ and 30 kg K₂O ha⁻¹)
2. 125% RDF (25 kg N, 62.5 kg P₂O₅ and 37.5 kg K₂O ha⁻¹)
3. 150 % RDF (30 kg N, 75 kg P₂O₅ and 45 kg K₂O ha⁻¹)
4. Sulfentrazone 300 g ha⁻¹ as PE

Sub plot (Weed management)

1. Metribuzin 0.4 kg ha⁻¹ + Oxyfluorfen 0.3 kg ha⁻¹ as PE
2. (Imazethapyr 35% + Imazamox 35%) 100 g ha⁻¹ as PoE
3. (Pendimethalin 30 % EC + Imazethapyr 2%) 1.0 kg ha⁻¹ as PE
5. Oxyfluorfen 0.3 kg ha⁻¹ as PE fb Imazethapyr 50 g ha⁻¹ as PoE
6. Imazethapyr 50 g ha⁻¹ as PE fb Metribuzin 0.3 kg ha⁻¹ as PoE
7. Control

Agronomic Efficiency (AE):

The agronomic efficiency is defined as the economic production obtained per unit of nutrient applied. It was calculated by using the following formula:

$$\text{Agronomic Efficiency} = \frac{\text{Economic yield}}{\text{kg nutrient applied}}$$

Production Efficiency (PE)

Production efficiency of chickpea was calculated by using the formula given by Tomar and Tiwari (1990).

$$\text{Production Efficiency (kg ha}^{-1} \text{ day}^{-1}) = \frac{\text{Seed Yield (kg ha}^{-1})}{\text{Duration of the crop (days)}}$$

Productivity Rating Index (PRI):

Productivity Rating Index was calculated by using the following formula :

Productivity Rating Index =

$$\frac{\text{Yield obtained from experimental plot (q ha}^{-1})}{\text{Standard yield (q ha}^{-1})}$$

All observations were statistically analyzed as suggested by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Yield attributes

Table 1 shows that 125% RDF resulted in significantly higher seed yield of 1530 kg ha⁻¹ and 1789 kg ha⁻¹ during 2013-14 and 2014-15, respectively compared to other nutrient management practices, whereas, higher stover yield was obtained with 150% RDF *i.e.* 1824 kg ha⁻¹ and 2115 kg ha⁻¹ during 2013-14 and 2014-15, respectively and harvest index was higher in case of 100% RDF with 47.35% and 46.22% during 2013-14 and 2014-15, respectively.

The lower seed yield *i.e.* 1349 kg ha⁻¹ and 1585 kg ha⁻¹ during 2013-14 and 2014-15,

Table 1. Effect of nutrient and weed management on Production Efficiency, Productivity Rating Index and Agronomic Efficiency in chickpea

Treatments	Seed yield (kg ha ⁻¹)		Stover yield (kg ha ⁻¹)		Harvest Index (%)		Production Efficiency (kg ha ⁻¹ day ⁻¹)		Productivity Rating Index		Agronomic Efficiency (yield/kg nutrient)	
	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
Nutrient management												
N ₁	1488	1713	1636	1952	47.35	46.22	12.72	14.77	0.74	0.86	14.88	17.13
N ₂	1530	1789	1808	2098	44.98	45.25	13.08	15.42	0.77	0.89	12.24	14.31
N ₃	1349	1585	1824	2115	41.59	42.25	11.53	13.66	0.67	0.79	8.99	10.57
SEM±	0.32	0.34	0.33	0.29	0.25	0.30	0.27	0.29	0.02	0.02	0.21	0.30
CD (P≤0.05)	1.25	1.33	1.30	1.15	0.97	1.18	1.07	1.14	0.06	0.07	0.82	1.19
Weed management												
W ₁	1956	2176	2104	2377	48.18	47.79	16.72	18.76	0.98	1.09	16.16	17.98
W ₂	1297	1574	1583	1945	45.12	44.70	11.08	13.57	0.65	0.79	10.67	12.94
W ₃	1575	1798	1876	2162	45.66	45.42	13.46	15.50	0.79	0.90	12.95	14.80
W ₄	1663	1918	1972	2255	45.80	45.99	14.21	16.53	0.83	0.96	13.68	15.79
W ₅	1747	2058	2009	2292	46.63	47.39	14.93	17.74	0.87	1.03	14.44	17.03
W ₆	701	841	1170	1452	36.71	36.53	5.99	7.25	0.35	0.42	6.07	7.11
W ₇	1251	1504	1578	1901	44.37	44.20	10.69	12.97	0.63	0.75	10.30	12.36
SEM±	0.42	0.34	0.43	0.37	0.91	0.67	0.36	0.29	0.02	0.02	0.32	0.33
CD (P≤0.05)	1.20	0.97	1.24	1.07	2.61	1.92	1.03	0.84	0.06	0.05	0.90	0.94
N X W	S	S	NS	NS	NS	NS	S	S	S	S	S	S
W X N	S	S	NS	NS	NS	NS	S	S	S	S	S	S

N₁- 100% RDF, N₂- 125% RDF, N₃- 150% RDFW₁- Metribuzin 0.4 kg ha⁻¹+ Oxyfluorfen 0.3 kg ha⁻¹ as PEW₂- (Imazethapyr 35% + Imazamox 35%) 100 g ha⁻¹ as PoEW₃- (Pendimethalin 30 % EC + Imazethapyr 2%) 1.0 kg ha⁻¹as PEW₄- Sulfentrazone 300 g ha⁻¹as PEW₅- Oxyfluorfen 0.3 kg ha⁻¹as PE fb Imazethapyr 50 g ha⁻¹as PoEW₆- Imazethapyr 50 g ha⁻¹as PE fb Metribuzin 0.3 kg ha⁻¹as PoEW₇- Control

S: Significant; NS: Non- Significant

respectively and harvest index of 41.59% and 42.25% during 2013-14 and 2014-15, respectively was recorded in 150% RDF, whereas, the lower stover yield of 1636 kg ha⁻¹ and 1952 kg ha⁻¹ during 2013-14 and 2014-15, respectively was observed in 100% RDF.

Weed management practices exerted significant impact on seed and stover yield and harvest index of chickpea. The higher seed yield of 1956 kg ha⁻¹ and 2176 kg ha⁻¹ during 2013-14 and 2014-15, respectively and stover yield of 2104 kg ha⁻¹ and 2377 kg ha⁻¹ during 2013-14 and 2014-15, respectively and harvest index of 48.18 % and 47.79 % during 2013-14 and 2014-15, respectively was recorded with Metribuzin 0.4 kg ha⁻¹+ Oxyfluorfen 0.3 kg ha⁻¹ as PE. The lower seed yield of 701 kg ha⁻¹ and 841 kg ha⁻¹ during 2013-14 and 2014-15, respectively and stover yield of 1170 kg ha⁻¹ and 1452 kg ha⁻¹ during 2013-14 and 2014-15, respectively and harvest index of 36.71% and 36.53 % during 2013-14 and 2014-15, respectively was recorded with Imazethapyr 50 g ha⁻¹ as PE fb Metribuzin 0.3 kg ha⁻¹ as PoE.

The interaction effect of nutrient management and weed management practices was significant on seed yield but non-significant with stover yield and harvest index.

The higher seed yield was under interaction of 125% RDF and pre-emergence application of metribuzin 0.4 kg ha⁻¹ + oxyfluorfen 0.3 kg ha⁻¹ with 2051 kg ha⁻¹ and 2307 kg ha⁻¹ during 2013-14 and 2014-15, respectively. The lower seed yield was under interaction of 100% RDF and imazethapyr 50 g ha⁻¹ as PE fb metribuzin 0.3 kg ha⁻¹ as PoE with 467 kg ha⁻¹ and 682 kg ha⁻¹ during 2013-14 and 2014-15, respectively (Table 2).

Higher yield in nutrient management was due to higher dry matter accumulation of plant. Higher seed and stover yield under above treatments was due to the weed managed at critical period and early crop growth, higher dry matter production, high

growth and ultimately high yield. Lower weed population and higher weed control efficiency also resulted in higher seed and stover yield. The lower harvest index in nutrient management was due to the fact that more amount of nutrients significantly reduced grain yield as a result of excessive vegetative growth at the expense of pod formation. Kadam *et al.* (2014) reported that among different fertility management treatments, application of 125% RDF produced higher grain (2553 kg ha⁻¹) and stover yield (4881 kg ha⁻¹) which was at par with 100% RDF+ biofertilizer.

Agronomic Efficiency (%), Production Efficiency (kg ha⁻¹ day⁻¹) and Productivity Rating Index

Agronomic efficiency of chickpea was significantly influenced by nutrient management. 100% RDF resulted in significantly higher agronomic efficiency of 14.88 and 17.13% during 2013-14 and 2014-15, respectively (Table 1) compared to other nutrient management practices. Whereas, higher production efficiency of 13.08 kg ha⁻¹ day⁻¹ and 15.42 kg ha⁻¹ day⁻¹ during 2013-14 and 2014-15, respectively and productivity rating index of 0.77 and 0.89 during 2013-14 and 2014-15, respectively was under 125% RDF. The lower agronomic efficiency *i.e.* 8.99% and 10.57% during 2013-14 and 2014-15, respectively, production efficiency of 11.53 kg ha⁻¹ day⁻¹ and 13.66 kg ha⁻¹ day⁻¹ during 2013-14 and 2014-15, respectively and productivity rating index of 0.67 and 0.79 during 2013-14 and 2014-15, respectively was under 150% RDF.

Weed management practices exerted significant impact on agronomic efficiency, production efficiency and productivity rating index of chickpea. The higher agronomic efficiency of 16.16% and 17.98% during 2013-14 and 2014-15, respectively, production efficiency with 16.72 kg ha⁻¹ day⁻¹ and 18.76 kg ha⁻¹ day⁻¹ during 2013-14 and 2014-15, respectively and productivity rating index with 0.98 and 1.09 during 2013-14 and 2014-15, respectively was under metribuzin 0.4 kg ha⁻¹+ oxyfluorfen 0.3

kg ha⁻¹ as PE. The lower agronomic efficiency *i.e.* 6.07% and 7.11% during 2013-14 and 2014-15, respectively, production efficiency with 5.99 kg ha⁻¹ day⁻¹ and 7.25 kg ha⁻¹ day⁻¹ during 2013-14 and 2014-15, respectively and productivity rating index with 0.35 and 0.42 during 2013-14 and 2014-15, respectively was under imazethapyr 50 g ha⁻¹ as PE fb metribuzin 0.3 kg ha⁻¹ as PoE.

The interaction effect of nutrient management and weed management practices was significant on agronomic efficiency and production efficiency.

The maximum agronomic efficiency (Table 3) was under interaction of 100% RDF with pre-emergence application of metribuzin 0.4 kg ha⁻¹ + oxyfluorfen 0.3 kg ha⁻¹ (19.85% and 22.00% during 2013-14 and 2014-15, respectively). The lower agronomic efficiency was under interaction of 100% RDF with imazethapyr 50 g ha⁻¹ as PE fb metribuzin 0.3 kg ha⁻¹ as PoE (3.11% and 4.55% during 2013-14 and 2014-15, respectively). It was observed that at the same level of weed management, the production efficiency was increased significantly with increase in the level of nutrient management from 100% to 125% but decreased at 150% RDF. The production efficiency was higher under interaction of 125% RDF and pre-emergence application of metribuzin 0.4 kg ha⁻¹ + oxyfluorfen 0.3 kg ha⁻¹ with 17.53% and 19.89% during 2013-14 and 2014-15, respectively.

The higher agronomic efficiency, production efficiency and productivity rating index in above treatments might be due to higher yield per kg of nutrients applied.

Nutrient status

Nutrient uptake by seed and stover

Significant effect of nutrient uptake by chickpea seed and stover was observed due to nutrient management. Higher nutrient uptake by seed was observed under 125% RDF with nitrogen 48.47

kg ha⁻¹ and 55.66 kg ha⁻¹ during 2013-14 and 2014-15, respectively, phosphorus uptake with 9.72 kg ha⁻¹ and 11.78 kg ha⁻¹ during 2013-14 and 2014-15, respectively, potassium uptake with 7.26 kg ha⁻¹ and 7.66 kg ha⁻¹ during 2013-14 and 2014-15, respectively and higher nitrogen uptake by stover *i.e.* 16.60 kg ha⁻¹ and 19.34 kg ha⁻¹ during 2013-14 and 2014-15, respectively, phosphorus uptake with 7.79 kg ha⁻¹ and 11.08 kg ha⁻¹ during 2013-14 and 2014-15, respectively, potassium uptake with 15.13 kg ha⁻¹ and 18.66 kg ha⁻¹ during 2013-14 and 2014-15, respectively was observed under 150% RDF (Table 4). The lower nutrient uptake by seed and stover was under 150% RDF.

Among weed management practices, all the herbicide treatments proved significantly superior to control except Imazethapyr 50 g ha⁻¹ as PE fb Metribuzin 0.3 kg ha⁻¹ as PoE w.r.t nutrient uptake by chickpea. Among herbicide treatments, significantly higher nitrogen uptake by seed *i.e.* 63.59 kg ha⁻¹ and 72.00 kg ha⁻¹ during 2013-14 and 2014-15, respectively phosphorus uptake with 13.78 kg ha⁻¹ and 15.72 kg ha⁻¹ during 2013-14 and 2014-15, respectively, potassium uptake with 9.93 kg ha⁻¹ and 9.65 kg ha⁻¹ during 2013-14 and 2014-15, respectively, nitrogen uptake by stover with 18.8 kg ha⁻¹ and 22.31 kg ha⁻¹ during 2013-14 and 2014-15, respectively, phosphorus uptake by stover with 10.01 kg ha⁻¹ and 12.76 kg ha⁻¹ during 2013-14 and 2014-15, respectively, potassium uptake by stover with 18.66 kg ha⁻¹ and 21.59 kg ha⁻¹ during 2013-14 and 2014-15, respectively were found with Metribuzin 0.4 kg ha⁻¹ + Oxyfluorfen 0.3 kg ha⁻¹ as PE. Minimum uptake of nutrients by seed and stover was observed under Imazethapyr 50 g ha⁻¹ as PE fb Metribuzin 0.3 kg ha⁻¹ as PoE.

Interaction effect of nutrient management and weed management practices on nutrient uptake by chickpea was non-significant.

The higher N, P, K uptake by chickpea under various treatments of weed management was

Table 2. Interaction effect of nutrient and weed management on seed yield of chickpea

Nutrient management / Weed management	Seed yield (kg ha ⁻¹)					
	N ₁		N ₂		N ₃	
	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
W ₁	1985	2200	2051	2307	1832	2023
W ₂	1245	1513	1444	1721	1201	1487
W ₃	1526	1766	1701	1907	1497	1720
W ₄	1656	1916	1705	1976	1628	1861
W ₅	1785	2107	1820	2200	1636	1868
W ₆	467	682	640	807	997	1033
W ₇	1223	1457	1351	1604	1180	1453
	SEm±			CD (P ≤ 0.05)		
2 W at same N		0.72	0.59		2.08	1.69
2 N at same W		0.74	0.64		2.27	2.03

due to effective control of weeds by these treatments which resulted in lower weed competition lead to vigorous rooting and better nodulation which cause profuse growth of crop plants and more uptake of nitrogen and there by more availability of nutrients to crop. Gautam (1999) reported that nutrient removal of crop significantly enhanced in weed free condition. Kumar *et al.* (2014) reported that fertilizer levels significantly influenced the N, P, K content as well as their uptake by chickpea seeds and stover. Application of 100% RDF showed highest values for the N, P, K content and their uptake by chickpea seeds and stover.

Nutrient status in soil (kg ha⁻¹)

Significant difference was observed in nutrient status of soil due to nutrient management (Table 5). Significantly higher nutrient status was under 150% RDF with 209.9 kg ha⁻¹ and 199 kg ha⁻¹ nitrogen during 2013-14 and 2014-15, respectively; 17 kg ha⁻¹ phosphorus and 21 kg ha⁻¹ phosphorus during 2013-14 and 2014-15, respectively; 300 kg ha⁻¹ potassium and 316 kg ha⁻¹ potassium during

2013-14 and 2014-15, respectively (Table 5). Lower nutrient status was under 100% RDF with 194 kg ha⁻¹ nitrogen and 185 kg ha⁻¹ nitrogen during 2013-14 and 2014-15, respectively; 15 kg ha⁻¹ phosphorus and 18 kg ha⁻¹ phosphorus during 2013-14 and 2014-15, respectively; 283 kg ha⁻¹ potassium and 298 kg ha⁻¹ potassium during 2013-14 and 2014-15, respectively.

Among weed management practices, nitrogen content *i.e.* 220 kg ha⁻¹ and 209 kg ha⁻¹ during 2013-14 and 2014-15, respectively were higher with (Pendimethalin 30 % EC + Imazethapyr 2%) 1.0 kg ha⁻¹ as PE. Phosphorus content of 23 kg ha⁻¹ and 26 kg ha⁻¹ during 2013-14 and 2014-15, respectively were higher with Imazethapyr 50 g ha⁻¹ as PE fb Metribuzin 0.3 kg ha⁻¹ as PoE and potassium content *i.e.* 315 kg ha⁻¹ and 335 kg ha⁻¹ during 2013-14 and 2014-15, respectively were higher with Imazethapyr 50 g ha⁻¹ as PE fb Metribuzin 0.3 kg ha⁻¹ as PoE. The lower nutrient status was under Control. Trimurtulu *et al.* (2015) from Guntur reported that nutrient status in soil was the highest in plot

Table 3. Interaction effect of nutrient and weed management on agronomic efficiency and production efficiency of chickpea

Nutrient management / weed management	Agronomic efficiency (Yield kg ⁻¹ nutrient)						Production efficiency (kg ha ⁻¹ day ⁻¹)					
	N1		N2		N3		N1		N2		N3	
	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
W1	19.85	22.00	16.41	18.45	12.21	13.48	16.97	18.97	17.53	19.89	15.66	17.44
W2	12.45	15.13	11.55	13.77	8.01	9.92	10.64	13.04	12.34	14.83	10.27	12.82
W3	15.26	17.66	13.61	15.26	9.98	11.47	13.05	15.22	14.54	16.44	12.79	14.83
W4	16.56	19.16	13.64	15.81	10.85	12.41	14.15	16.52	14.58	17.03	13.91	16.05
W5	17.85	21.07	14.56	17.60	10.91	12.45	15.26	18.17	15.55	18.97	13.98	16.10
W6	3.11	4.55	5.12	6.46	9.97	10.33	3.99	5.88	5.47	6.96	8.52	8.91
W7	12.23	14.57	10.81	12.83	7.87	9.68	10.45	12.56	11.54	13.83	10.09	12.52
	SEM±						SEM±					
	CD (P ≤ 0.05)						CD (P ≤ 0.05)					
2 W at same N		0.55		0.57	1.57	1.63	0.62	0.51			1.78	1.46
2 N at same W		0.55		0.61	1.65	1.90	0.63	0.55			1.94	1.75

Table 4. Effect of nutrient and weed management on nutrient uptake (kg ha⁻¹) by chickpea

Treatments	Nitrogen uptake (kg ha ⁻¹)				Phosphorus uptake (kg ha ⁻¹)				Potassium uptake (kg ha ⁻¹)			
	Seed		Stover		Seed		Stover		Seed		Stover	
Nutrient management	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
N ₁	44.08	51.51	12.31	14.72	8.35	10.46	6.74	9.70	5.98	6.35	13.98	16.46
N ₂	48.47	55.66	15.67	18.74	9.72	11.78	7.68	10.47	7.26	7.66	14.68	17.71
N ₃	41.72	50.54	16.60	19.34	8.95	11.17	7.79	11.08	6.93	6.92	15.13	18.66
SEM±	0.66	0.93	0.35	0.24	0.21	0.16	0.15	0.20	0.16	0.23	0.19	0.26
CD (P ≤ 0.05)	2.57	3.65	1.39	0.93	0.82	0.61	0.59	0.79	0.63	0.91	0.75	1.04
Weed management	63.59	72.00	18.80	22.31	13.78	15.72	10.01	12.76	9.93	9.65	18.66	21.59
W ₁	38.89	48.27	13.45	15.74	7.44	9.87	6.41	10.13	5.99	6.34	13.21	16.58
W ₂	48.29	55.62	16.31	18.72	9.83	11.58	7.86	11.48	7.18	7.38	16.02	19.15
W ₃	52.14	59.78	17.63	19.91	10.26	12.89	8.18	12.05	7.51	7.83	16.72	20.16
W ₄	55.74	66.10	17.97	21.25	11.17	14.23	9.36	12.30	8.89	9.13	17.20	20.56
W ₅	17.39	21.08	7.75	10.39	3.44	4.19	3.77	4.78	2.16	2.50	7.69	9.59
W ₆	37.27	45.13	12.14	14.87	7.11	9.33	6.38	9.41	5.39	6.03	12.68	15.63
SEM±	1.57	1.55	0.60	0.63	0.27	0.24	0.23	0.29	0.25	0.24	0.61	0.79
CD (P ≤ 0.05)	4.51	4.43	1.73	1.80	0.79	0.68	0.65	0.82	0.72	0.68	1.75	2.26
N X W	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
W X N	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 5. Effect of nutrient and weed management on soil nutrient status (kg ha⁻¹) in soil in chickpea

Treatments	N in soil (kg ha ⁻¹)		P in soil (kg ha ⁻¹)		K in soil (kg ha ⁻¹)	
	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
Nutrient management						
N ₁	194	185	15	18	283	298
N ₂	207	194	16	20	294	308
N ₃	210	199	17	21	300	316
SEm±	2.01	2.20	0.40	0.55	2.96	3.07
CD (P ≤ 0.05)	7.90	8.78	1.57	2.16	11.61	12.07
Weed management						
W ₁	204	193	19	23	300	315
W ₂	196	183	13	16	285	299
W ₃	220	209	14	17	287	301
W ₄	210	200	16	20	289	301
W ₅	207	197	18	22	294	311
W ₆	200	193	23	26	315	335
W ₇	189	175	11	14	273	290
SEm±	3.72	3.29	1.00	0.91	4.61	4.65
CD (P ≤ 0.05)	10.68	9.43	2.86	2.60	13.22	13.33
N X W	NS	NS	NS	NS	NS	NS
W X N	NS	NS	NS	NS	NS	NS

Initial: 2013- N: 213, P:13, K:300; 2014 - 210, P:13, K:307 kg ha⁻¹, respectively

treated with oxyfluorfen @ 1 kg ha⁻¹ (390 kg N ha⁻¹ and 31 kg P₂O₅ ha⁻¹) and organic carbon with 0.42 %.

Nutrient uptake by weeds (kg ha⁻¹)

Nutrient management showed significant effect on nutrient uptake by weeds. 100% RDF showed significantly the lower nitrogen uptake of 20.65 kg ha⁻¹ and 16.59 kg ha⁻¹ during 2013-14 and 2014-15, respectively, phosphorus uptake of 1.8 kg ha⁻¹ and 1.65 kg ha⁻¹ during 2013-14 and 2014-15, respectively and potassium uptake of 7.27 kg ha⁻¹ and 6.24 kg ha⁻¹ during 2013-14 and 2014-15, respectively (Table 6). 150% RDF showed the higher nitrogen uptake of 23.12 kg ha⁻¹ and 19.54 kg ha⁻¹ during 2013-14 and 2014-15, respectively,

phosphorus uptake of 2.13 kg ha⁻¹ and 1.94 kg ha⁻¹ during 2013-14 and 2014-15, respectively and potassium uptake of 8.09 kg ha⁻¹ and 7.35 kg ha⁻¹ during 2013-14 and 2014-15, respectively.

Among weed management practices, higher nitrogen uptake of 41.82 kg ha⁻¹ and 38.15 kg ha⁻¹ during 2013-14 and 2014-15, respectively, phosphorus uptake of 3.92 kg ha⁻¹ and 3.59 kg ha⁻¹ during 2013-14 and 2014-15, respectively and potassium uptake of 12.08 kg ha⁻¹ and 10.96 kg ha⁻¹ during 2013-14 and 2014-15, respectively was recorded in control, whereas, Imazethapyr 50 g ha⁻¹ as PE fb Metribuzin 0.3 kg ha⁻¹ as PoE showed minimum uptake of nutrients *i.e.* 10.89 and 7.23 kg ha⁻¹ during 2013-14 and 2014-15, respectively of

Table 6. Effect of nutrient and weed management on nutrient uptake (kg ha⁻¹) by weeds in chickpea

Treatments	N uptake by weeds (kg ha ⁻¹)		P uptake by weeds (kg ha ⁻¹)		K uptake by weeds (kg ha ⁻¹)	
	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
Nutrient management						
N ₁	20.65	16.59	1.80	1.65	7.27	6.24
N ₂	21.71	17.17	2.01	1.77	7.81	7.27
N ₃	23.12	19.54	2.13	1.94	8.09	7.35
SEm±	0.35	0.37	0.06	0.05	0.14	0.19
CD (P ≤ 0.05)	1.36	1.45	0.22	0.18	0.54	0.74
Weed management						
W ₁	12.04	7.76	0.81	0.75	3.96	3.23
W ₂	38.05	32.62	3.48	3.23	11.00	10.27
W ₃	19.10	15.10	2.08	1.93	9.40	8.66
W ₄	15.70	12.03	1.67	1.38	8.08	7.35
W ₅	15.17	11.50	1.15	1.01	5.65	5.03
W ₆	10.89	7.23	0.76	0.68	3.90	3.17
W ₇	41.82	38.15	3.92	3.59	12.08	10.96
SEm±	0.53	0.63	0.12	0.11	0.24	0.23
CD (P ≤ 0.05)	1.52	1.82	0.34	0.32	0.70	0.67
N X W	NS	NS	NS	NS	NS	NS
W X N	NS	NS	NS	NS	NS	NS

nitrogen, 0.76 kg ha⁻¹ and 0.68 kg ha⁻¹ during 2013-14 and 2014-15, respectively of phosphorus uptake and 3.9 kg ha⁻¹ and 3.17 kg ha⁻¹ during 2013-14 and 2014-15, respectively of potassium which was at par with Metribuzin 0.4 kg ha⁻¹+ Oxyfluorfen 0.3 kg ha⁻¹ as PE.

Nutrient uptake by weeds was higher because of more number of weeds which lead to more competition for nutrients.

Crude protein % and yield of seed and stover

Nutrient management showed significant difference on crude protein per cent. 125% RDF obtained significantly higher crude protein % of seed *i.e.* 19.24% and 19.55 % during 2013-14 and 2014-15, respectively, crude protein yield of seed *i.e.* 302

kg ha⁻¹ and 356 kg ha⁻¹ during 2013-14 and 2014-15, respectively and higher crude protein % of stover under 150% RDF *i.e.* 5.7 and 5.65 % during 2013-14 and 2014-15, respectively and crude protein yield of stover with 106 kg ha⁻¹ and 121 kg ha⁻¹ during 2013-14 and 2014-15, respectively (Table 7). The lower crude protein % of seed and stover was under 100% RDF.

Among weed management practices, Metribuzin 0.4 kg ha⁻¹+ Oxyfluorfen 0.3 kg ha⁻¹ as PE was significantly superior over other herbicides with seed crude protein content of 20.31% and 20.74 % during 2013-14 and 2014-15, respectively and crude protein seed yield of 397 kg ha⁻¹ and 452 kg ha⁻¹ during 2013-14 and 2014-15, respectively and

Table 7. Effect of nutrient and weed management on crude protein % and crude protein yield (kg ha⁻¹) of chickpea

Treatments	Crude Protein % seed		Crude Protein % stover		Crude Protein Yield seed (kg ha ⁻¹)		Crude Protein Yield stover (kg ha ⁻¹)	
	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
Nutrient management								
N ₁	18.28	18.49	4.64	4.66	276	332	77	92
N ₂	19.24	19.55	5.38	5.51	302	356	99	117
N ₃	18.91	19.12	5.70	5.65	261	308	106	121
SEM±	0.18	0.15	0.11	0.12	0.07	0.07	0.02	0.02
CD (P ≤ 0.05)	0.71	0.58	0.43	0.49	0.26	0.26	0.09	0.06
Weed management								
W ₁	20.31	20.74	5.95	5.86	397	452	125	139
W ₂	18.74	19.15	5.24	5.04	243	302	084	98
W ₃	19.11	19.34	5.38	5.41	302	348	102	118
W ₄	19.60	19.48	5.55	5.50	326	373	110	124
W ₅	19.96	20.10	5.58	5.76	348	414	113	133
W ₆	15.35	15.83	4.19	4.51	107	131	48	65
W ₇	18.61	18.75	4.76	4.85	233	282	76	93
SEM±	0.54	0.49	0.25	0.17	0.10	0.10	0.04	0.04
CD (P ≤ 0.05)	1.56	1.40	0.70	0.50	0.28	0.27	0.12	0.11
N X W	NS	NS	NS	NS	NS	NS	NS	NS
W X N	NS	NS	NS	NS	NS	NS	NS	NS

crude protein % of stover *i.e.* 5.95% and 5.86 % during 2013-14 and 2014-15, respectively and crude protein yield of stover *i.e.* 125 kg ha⁻¹ and 139 kg ha⁻¹ during 2013-14 and 2014-15, respectively. The lower crude protein % of seed and stover was under Imazethapyr 50 g ha⁻¹ as PE fb Metribuzin 0.3 kg ha⁻¹ as PoE.

Increased crude protein per cent might be due to the higher uptake of nitrogen. Crude protein yield is directly related to crude protein percent and yield. Increased crude protein yield might be due to the higher uptake of nitrogen and higher yield.

CONCLUSION

It was recorded that 125% RDF was the best in enhancing seed yield, nutrient uptake by seed, crude protein yield and production efficiency. Whereas, 150% RDF was the best w.r.t stover yield and nutrient uptake by stover. It was observed that 100% RDF was the best in agronomic efficiency. Among weed management practices, metribuzin 0.4 kg ha⁻¹ + oxyfluorfen 0.3 kg ha⁻¹ as PE was observed as best treatment in enhancing yield, nutrient uptake by seed and stover, crude protein yield and efficiency. Further, 125% RDF with metribuzin 0.4 kg ha⁻¹ + oxyfluorfen 0.3 kg ha⁻¹ as PE is the best practice recommended.

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EVALUATION OF RICE (*Oryza sativa* L.) GENOTYPES FOR GRAIN YIELD, YIELD COMPONENTS AND NUTRITIONAL TRAITS FOR SCARCE RAINFALL ZONE OF ANDHRA PRADESH

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ABSTRACT

Thirty-eight selected rice genotypes were grown during *Kharif*, 2017 in order to evaluate the performance of elite accessions of rice for 17 characters. The experiment was laid out in randomized complete block design with three replications. Analysis of variance for all quantitative and qualitative traits showed that mean sum of squares due to genotypes was highly significant for all characters studied. Among the tested genotypes, MTU 1064 was found to be the best as it excelled for grain yield, panicle length, 1000 grain weight, harvest index and protein content followed by MTU 1081, PD 10 and NLR 4002 which are the slender grain types and found to have superior grain quality features and nutritional traits, apart from having high yield potential. High iron content was found in MTU 1031. Whereas, PLA 1100 had maximum zinc content which has proven its suitability for utilization in breeding programmes to develop Zn fortified rice.

INTRODUCTION

Rice (*Oryza sativa* L.) has shaped the cultures, diets and economics of billions of people living in Asia. Global demand for food is rising because of population growth, increasing affluence and changing dietary habits (Chowdhury *et al.*, 2016). To meet this demand, the global food production needs increase by over 40 per cent by 2030 and 70 per cent by 2050.

The poorest families in developing countries spend about 50%- 80% of their income on food, depend heavily on low cost, high energy, starchy staples such as rice which contains insufficient amounts of nutrients such as iron, zinc and protein to provide recommended daily intake for human beings (Dharwal *et al.*, 2017). However, as with many other staple food crops, rice contains low levels of proteins and important micronutrients. Hence, producing enough food energy to maintain the world's population is not enough. Along with the high yielding rice varieties, preference to fine grain and high nutritional quality genotypes reduces malnutrition. Considering the above factors, the research was

undertaken to study the *per se* performance of agronomic, quality and nutritional traits in thirty - eight rice genotypes.

MATERIAL AND METHODS

The experiment was conducted at the College Farm of Agricultural College, Mahanandi during *Kharif*, 2017. The genotypes were sown in rows spaced at 20 cm apart with intra row spacing of 15 cm with three replications each. The recommended doses of fertilizer *i.e.* 240 kg ha⁻¹ N in the form of Urea; 80 kg ha⁻¹ P₂O₅ in the form of single super phosphate (SSP) and 80 kg ha⁻¹ K₂O in the form of muriate of potash (MOP) was applied. All necessary measures were taken to control pest and disease infestation. Analysis of variance and mean performance of genotypes was carried out for morphological and nutritional traits *viz.*, days to 50 per cent flowering, days to maturity, plant height (cm), number of productive tillers plant⁻¹, panicle length (cms), panicle weight (g), number of filled spikelets panicle⁻¹, kernel length (mm), kernel breadth (mm), kernel L/B ratio (L/B), 1000 grain weight (g), harvest

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index (%), grain yield plant⁻¹ (g), protein content (%), iron content (ppm) and zinc content (ppm).

Zinc and Iron content were estimated in seed extract after digestion using tri acid mixture by using Atomic Absorption Spectrophotometer (AAS) at 213.86 nm for zinc and 248.33 nm for iron.

RESULTS AND DISCUSSION

The phenotypic variation manifested by the genotype has two components namely genotypic and environmental. Analysis of variance of among 17 characters revealed significant differences among the means of all the genotypes. Thus, indicated considerable scope for selection of high yielding and genotypes with more nutrients and quality. The differences can be attributed to variations present in the genotypes as well as the environmental factors.

Mean performance of genotypes for different yield components

Among the selected genotypes, NLR 3251 was on a par with the earliest (120 days) genotype. However, shortest plants were observed in NLR 4001 (99.73 cm). Number of productive tillers plant⁻¹ varied from 9.40 (MTU 5293) and 17.80 (NLR 4002) with an average of 12.98. Alternatively, long panicles were observed in RNR 15048 (27.87) and short in NLR 3041 (20.21) (Table 1). The genotype MTU 1081 recorded maximum panicle weight of 4.85g. These genotypes were also identified as potential ideotypes for breaking of yield plateaus being observed in rice breeding programmes in the recent years.

The overall mean for kernel length was 5.44 mm. The longest grains were possessed by PD 10 (6.68 mm), while the shortest by BPT 5204 (4.76 mm). Kernel breadth of less than 2.0 mm is preferred to fetch premium price commercially. The kernel breadth in studied genotypes ranged between 1.39 mm (RNR 15048) and 2.47 mm (BPT 2231) with an average of 1.94 mm. Kernel L/B ratio of 3.50 is considered to be ideal for quality rice. In the studied genotypes, kernel L/B ratio stretched to a tune of

2.23 (MTU 2077) and 3.86 (PD 10) with an average of 2.83. The tested genotypes were classified as slender (>3.0), medium (2.1-3.0), bold (1.1-2.0) and round (<1.0) based on the kernel L/B ratio (Mir *et al.*, 2013). Eight genotypes *viz.*, PD 10 (3.86), MTU 1081 (3.58), NLR 4002 (3.43), Rp Bio 226 (3.36), MTU 1031 (3.25), BPT 2698 (3.16), BPT 2673 (3.11) and BPT 2295 (3.10) were observed to be slender types (L/B ratio >3.0). The remaining 30 genotypes were found to be medium types.

1000 grain weight varied from 11.83g (RNR 15048) to 24.13g (PD 10) with an average of 16.57. Genotypes possessing higher harvest index could serve as better source for enhancing physiological efficiency and thereby yield. Harvest index ranged from 14.44 per cent (MTU 5293) to 48.51 per cent (NLR 3391) with a general mean of 29.92 per cent. Improvement of yield is the ultimate objective of any plant breeding activity owing to its economic importance. The general mean with respect to this trait grain yield plant⁻¹ was 30.12 g and the range was recorded between 11.95 g (MTU 5293) and 49.85g (MTU 1064). Therefore, the varieties, MTU 1064, MTU 1081, PD 10, NLR 4002 and NLR 3354 were identified to be the promising genotypes with respect to yield. Out of which, the genotypes namely, MTU 1081, PD 10, NLR 4002 found to have superior grain quality features and nutritional traits, apart from having high yield potential. Further, evaluation of these varieties across locations and seasons is essential before large scale recommendation.

The magnitude of phenotypic variability is reflected by range and deviation from the mean values. High range was noticed for number of filled spikelets panicle⁻¹ (82.53 and 231.56) followed by days to maturity (120.00 and 158.33), plant height (99.73 cm and 141.06 cm) days to 50 per cent flowering (90.00 and 128.00), grain yield plant⁻¹ (11.95g and 49.84g), harvest index (14.44% and 48.51%), SPAD chlorophyll meter reading (36.16 and 43.68), panicle length (20.21cm and 27.86 cm), 1000

Table 1. Mean performance of 38 rice genotypes for yield and yield attributes

S.No	ENTRIES	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of productive tiller plant ⁻¹	Panicle length (cm)	Panicle weight (g)	Number of filled spikelets panicle ⁻¹	Kernel length (mm)	Kernel breadth (mm)	Kernel L/B ratio	1000 grain Weight (g)	Harvest Index (%)	Grain yield (g plant ⁻¹)	SPAD chloro-phyll meter reading (SCMR)
1	NDLR 7	106.00	136.00	116.90	14.00	22.00	2.71	144.87	5.25	1.88	2.78	13.00	24.41	15.56	41.05
2	NDLR 8	103.67	133.67	101.97	9.87	23.33	2.55	177.73	5.30	1.82	2.89	12.42	26.12	20.02	40.50
3	MTU 7029	113.00	143.00	110.27	12.33	22.60	2.98	167.07	5.68	1.96	2.90	18.53	30.67	34.37	38.52
4	MTU 1075	110.67	140.67	127.53	14.47	23.74	3.60	168.13	5.86	2.02	2.91	18.53	33.75	37.06	37.08
5	MTU 1061	118.33	148.33	124.60	12.07	24.82	2.90	115.00	5.71	2.02	2.83	18.41	28.90	28.28	40.62
6	MTU 1064	120.33	150.33	122.00	14.07	26.50	3.52	118.20	5.51	2.06	2.68	18.59	39.15	49.85	40.19
7	MTU 1031	124.67	154.67	116.73	11.73	25.87	3.86	129.20	5.54	1.71	3.25	18.75	28.05	29.11	38.27
8	MTU 1032	119.67	149.67	109.67	13.27	25.81	3.26	199.33	5.36	1.85	2.92	18.30	26.70	33.96	37.57
9	MTU 2076	110.00	140.00	112.13	14.53	23.59	2.47	127.73	5.39	2.16	2.49	19.88	24.45	24.50	38.55
10	MTU 2077	123.33	153.33	114.20	14.07	23.19	2.52	126.40	5.06	2.29	2.23	17.78	29.36	28.00	38.49
11	MTU 4870	117.00	147.00	120.40	10.60	24.06	3.11	144.27	5.55	2.30	2.42	20.33	24.79	24.65	37.29
12	MTU 5182	118.67	148.67	123.17	12.47	25.59	4.32	131.40	5.05	2.17	2.32	19.80	20.41	23.76	38.80
13	MTU 5293	116.00	146.00	112.13	9.40	22.93	2.57	119.87	5.47	2.21	2.47	17.51	14.44	11.95	36.17
14	MTU 1081	97.67	124.00	116.30	13.13	26.47	4.85	231.57	5.71	1.59	3.58	14.96	40.11	43.90	42.93
15	MTU 1078	120.33	151.00	120.83	13.33	23.65	3.15	154.58	5.05	2.01	2.51	15.41	26.26	26.99	37.49
16	PLA 1100	120.33	150.33	117.13	10.20	22.52	2.97	133.43	5.31	2.17	2.45	18.65	25.77	24.06	40.88
17	Rp Bio 226	102.33	132.33	113.27	9.73	23.11	2.43	134.73	5.30	1.58	3.36	13.62	28.62	20.60	37.79
18	Swarna Sub1	110.00	140.00	108.33	13.67	23.23	2.91	141.27	5.35	2.23	2.40	19.23	33.84	35.75	36.90
19	BPT 5204	105.00	135.00	111.30	12.80	22.28	2.24	146.20	4.76	1.79	2.65	13.34	21.58	18.73	36.33
20	BPT 3291	106.67	136.67	105.33	9.60	21.27	2.73	118.87	5.50	2.11	2.60	17.68	27.23	14.45	38.21
21	BPT 2270	120.33	150.33	118.70	10.07	21.73	2.46	82.53	5.15	1.78	2.90	12.58	20.16	20.63	39.44

Table-1 Contd...

S.No	ENTRIES	Days to 50% flow-ering	Days to matu-rity	Plant height (cm)	Number of productive tiller splant ⁻¹	Panicle length (cm)	Panicle weight (g)	Number of filled spikelets panicle ⁻¹	Kernel length (mm)	Kernel breadth (mm)	Kernel L/B ratio	1000 grain Weight (g)	Harvest Index (%)	Grain yield (g plant ⁻¹)	SPAD chloro-phyll meter reading (SCMR)
22	BPT 4358	103.67	133.67	114.13	10.00	24.65	2.94	156.40	5.03	1.68	2.99	12.89	26.23	19.58	38.44
23	BPT 2295	127.00	157.00	131.67	11.80	27.21	2.77	116.20	5.26	1.71	3.10	14.05	21.43	21.34	40.21
24	BPT 2231	128.33	158.33	115.07	12.87	24.49	2.30	102.67	5.66	2.47	2.39	16.75	25.59	25.84	39.68
25	NLR 4001	103.00	133.00	99.73	13.27	22.10	2.34	151.07	5.27	1.80	2.92	14.97	16.87	17.95	42.06
26	NLR 4002	90.67	120.67	112.73	17.80	24.83	3.35	162.67	6.53	1.91	3.43	21.69	39.85	41.47	42.29
27	RNR 15048	94.00	124.00	121.40	13.87	27.87	3.00	220.73	5.01	1.39	3.60	11.83	35.83	38.29	41.16
28	NLR 3304	94.00	124.00	108.60	17.47	23.07	3.87	218.73	5.50	2.02	2.73	14.92	35.78	38.00	41.51
29	NLR 3354	99.00	129.00	103.07	13.73	24.33	3.97	205.27	5.40	1.85	2.92	14.33	44.42	46.86	43.47
30	NLR 3251	90.00	120.00	108.87	16.27	23.32	3.78	201.93	5.54	2.15	2.58	15.40	42.62	40.66	40.80
31	NLR 3391	100.00	130.00	129.77	12.20	26.09	2.32	153.70	5.43	1.93	2.81	14.70	48.51	44.16	40.81
32	BPT 2698	114.00	144.00	141.07	13.13	26.64	3.28	191.77	5.64	1.79	3.16	15.38	22.93	30.24	38.46
33	NLR 3296	96.67	126.67	101.80	12.67	22.60	4.49	180.47	5.34	2.13	2.50	18.21	37.48	35.29	43.57
34	NLR 3346	97.67	127.66	117.33	13.07	25.49	4.16	172.93	5.39	1.91	2.83	16.82	41.49	33.81	39.75
35	MCM111	100.00	130.00	113.40	12.93	24.86	3.29	173.27	5.45	1.92	2.84	17.74	30.12	34.31	43.20
36	BPT 2673	113.00	143.00	133.93	16.20	24.27	3.87	204.80	5.87	1.89	3.11	15.51	28.61	39.51	42.98
37	NLR 3041	113.00	143.00	120.33	15.67	20.21	2.40	194.40	5.06	2.00	2.53	13.10	23.74	25.79	43.69
38	PD 10	92.00	123.00	114.00	14.93	26.46	4.34	144.80	6.68	1.73	3.86	24.13	40.88	45.47	37.22
	General Mean	108.94	138.89	116.04	12.98	24.12	3.17	156.95	5.44	1.94	2.83	16.57	29.92	30.12	39.79
	S.E±(m)	1.09	1.14	3.42	0.74	0.56	0.32	4.40	0.08	0.07	0.09	0.50	2.15	1.81	1.06
	C.D at 5%	3.08	3.23	9.64	2.08	1.59	0.91	12.40	0.22	0.22	0.26	1.41	6.08	5.12	3.01
	C.V %	1.74	1.43	5.11	9.87	4.06	17.72	4.85	2.55	7.10	5.77	5.24	12.50	10.44	4.65

Significant at 0.05 (0.18-0.24), 0.01 (>0.24) levels, respectively.

Table 2. Mean performance of 38 rice genotypes for nutritional traits

S.No	ENTRIES	Protein (%)	Fe content (ppm)	Zn content (ppm)
1	NDLR 7	8.46 (3.08)	5.97	9.60
2	NDLR 8	7.48 (2.91)	5.17	10.70
3	MTU 7029	8.47 (3.07)	5.43	9.43
4	MTU 1075	5.89 (2.62)	4.57	9.27
5	MTU 1061	8.37 (3.06)	6.20	10.90
6	MTU 1064	9.82 (3.28)	4.73	9.37
7	MTU 1031	6.42 (2.72)	7.37	10.00
8	MTU 1032	7.81 (2.96)	4.70	10.37
9	MTU 2076	7.71 (2.95)	4.67	9.10
10	MTU 2077	7.53 (2.92)	5.37	11.00
11	MTU 4870	5.80 (2.60)	5.00	11.30
12	MTU 5182	8.30 (3.04)	6.00	10.27
13	MTU 5293	5.80 (2.60)	4.90	10.73
14	MTU 1081	7.26 (2.87)	6.40	12.53
15	MTU 1078	5.92 (2.63)	5.07	10.00
16	PLA 1100	6.49 (2.73)	4.50	13.23
17	Rp Bio 226	7.34 (2.88)	5.07	11.10
18	Swarna Sub1	6.60 (2.75)	4.03	9.53
19	BPT 5204	7.81 (2.96)	4.77	10.03
20	BPT 3291	5.61 (2.57)	4.80	9.60
21	BPT 2270	7.35 (2.89)	5.47	11.40
22	BPT 4358	7.85 (2.97)	4.33	9.90
23	BPT 2295	7.97 (2.99)	4.90	10.87
24	BPT 2231	8.10 (3.01)	5.20	9.27
25	NLR 4001	5.68 (2.58)	4.73	9.40
26	NLR 4002	5.28 (2.50)	5.13	9.07
27	RNR 15048	9.32 (3.21)	4.10	8.33
28	NLR 3304	7.58 (2.92)	5.90	9.57
29	NLR 3354	7.59 (2.93)	5.27	9.70
30	NLR 3251	6.07 (2.65)	4.83	10.13
31	NLR 3391	5.51 (2.55)	5.30	10.10
32	BPT 2698	6.25 (2.69)	5.57	10.37
33	NLR 3296	7.14 (2.85)	5.43	9.33
34	NLR 3346	8.34 (3.05)	5.93	9.20
35	MCM 111	7.86 (2.97)	4.87	10.13
36	BPT 2673	8.15 (3.02)	4.30	9.33
37	NLR 3041	7.57 (2.92)	4.33	9.47
38	PD 10	9.31 (3.21)	5.63	9.27
General Mean		7.31 (2.87)	5.15	10.07
S.E± (m)		0.0222	0.2235	0.2475
C.D at 5%		0.626	0.6297	0.6974
CV %		1.337	7.5069	4.2545

* Values in the parenthesis indicate square root transformed values; Significant at 0.05 (0.18-0.24) , 0.01 (>0.24) levels, respectively

grain weight (11.82 g and 24.13 g), number of productive tillers plant⁻¹ (9.40 and 17.80), zinc content (8.33 ppm and 13.23 ppm), iron content (4.03 ppm and 7.36 ppm), kernel length (4.76 mm and 6.68 mm), panicle weight (2.24g and 4.85g), kernel L/B ratio (2.22 and 3.86), protein content (2.50% and 3.29%) and kernel breadth (1.39 mm and 2.46 mm) in decreasing order of their magnitude. Thus, demonstrated the existence of wide variability among the varieties studied for these traits. Similar results were obtained by Savitha *et al.* (2016) for number of filled grains per panicle, 1000 grain weight and harvest index; Pulgam *et al.* (2015) for grain yield plant⁻¹; Umadevi *et al.* (2016) for panicle length. Further, these genotypes can be involved in the crossing programme to develop high yielding rice varieties enriched with quality features.

Evaluation of genotypes for protein, iron and zinc content in rice grain

Per se performance of nutritional traits among the genotypes were recorded (Table 2). Biological and genetic improvement of rice grain with high amount of proteins is required to overcome the problem of protein energy malnutrition. Hence, the protein content evaluated in rice grain ranged from 5.28% (NLR 4002) to 9.82% (MTU 1064). However, ten genotypes *viz.*, MTU 1064 (9.82%), RNR 15048 (9.32%), PD 10 (9.31%), MTU 7029 (8.47%), NDLR 7 (8.46%), MTU 1061 (8.37%), NLR 3346 (8.34%), MTU 5182 (8.30%), BPT 2673 (8.15%) and BPT 2231 (8.10%) recorded significantly higher protein content over the mean (7.31). Similarly, development of varieties containing high amount of bioavailable Fe in rice grain is recommended for improving the iron intake in populations dependent on rice as a staple food for preventing and eradicating Fe deficiency. Iron content ranged from 4.03 ppm (Swarna Sub 1) to 7.36 ppm (MTU 1031). However, seven genotypes *viz.*, MTU 1031 (7.36 ppm), MTU 1081 (6.40 ppm), MTU 1061 (6.20 ppm), MTU 5182 (6.00), NDLR 7

(5.97 ppm), NLR 3346 (5.93 ppm), NLR 3304 (5.90 ppm) exhibited significantly superior iron content over the mean. Alternatively, zinc is an essential element for a balanced nutrition and strengthening of immune system in humans. In the study, zinc content ranged from 8.33 ppm (RNR 15048) to 13.23 ppm (PLA 1100). However, nine genotypes *viz.*, PLA 1100 (13.23 ppm), MTU 1081 (12.53 ppm), BPT 2270 (11.40 ppm), MTU 4870 (11.30 ppm), RP BIO 226 (11.10 ppm), MTU 2077 (11.00 ppm), MTU 1061 (10.90 ppm) and BPT 2295 (10.87 ppm) were found to be significantly superior with respect to zinc content over mean (8.33ppm). Similar results were reported by Chimmili *et al.* (2015) for protein and iron content and Patil *et al.* (2015) for zinc content.

CONCLUSION

Out of the 38 rice genotypes studied, the entries *viz.*, MTU 1064, MTU 1081, PD 10 and NLR 4002 are adjudged as promising genotypes not only for high yield and yield components, but also for superior grain quality features such as slenderness and nutritional qualities, which is preferred in the market and to fetch premium price. Therefore, these genotypes may be involved in the crossing programme for number of productive tillers per plant, number of filled spikelets per panicle, kernel L/B ratio, 1000 grain weight, harvest index, grain yield per plant and iron content by duly estimating their general and specific combining abilities in the future breeding programmes. Further, multi-location testing of these entries over years could be recommended to test their suitability and stability to Scarce Rainfall Zone of Andhra Pradesh.

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YIELD AND NUTRIENT UPTAKE OF FINGERMILLET AS INFLUENCED BY ORGANICS AND LIQUID BIOFERTILIZER CONSORTIUM

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ABSTRACT

Influence of organics and liquid bio fertilizer consortium on yield and nutrient uptake of finger millet was studied during *Kharif*, 2017. The results revealed that highest grain yield was recorded with seed treatment with *ghanajeevamritham* (STG) + soil application of *jeevamritham* (SAJ) + liquid bio fertilizer consortium (LBFC) (T_6) (1057 kg ha^{-1}) closely followed by RDF + LBFC (T_8) (1029 kg ha^{-1}), which were at par and significantly superior to the rest of the treatments. Highest nutrient uptake was with RDF + LBFC (T_8) ($89.1, 30.0$ and 106.7 kg ha^{-1}) followed by RDF (T_4) ($58.0 \text{ kg ha}^{-1}, 12.9 \text{ kg ha}^{-1}$ and 78.1 kg ha^{-1}) which were statistically on par with each other. Lowest grain yield and nutrient uptake was recorded with control (T_9). STG + SAJ and RDF in combination with liquid biofertilizer consortium holds promise as an appropriate technology for achieving efficient and economical way of nutrient supply and also higher yield in finger millet.

INTRODUCTION

Intensive cultivation, growing of exhaustive crops, use of unbalanced and inadequate fertilizers accompanied by restricted use of organic manures have made soils not only deficient in nutrients, but also deteriorated soil health resulting in decline in crop response to recommended dose of fertilizers. Boosting yield, reducing production cost and improving soil health are three interlinked components of sustainable triangle (Kumar and Yadav, 1995). Therefore, there is need to improve soil fertility and quality of economic product by use of organic manures and liquid biofertilizer consortium. Finger millet is the third most important millet, next to sorghum and pearl millet. In India, finger millet is grown over an area of 1.13 Million ha with an annual production of 1.98 Million tonnes and a productivity of 1661 kg ha^{-1} . In Andhra Pradesh, it is cultivated in an area of 44,000 ha with a production of 36,000 tonnes and having a productivity of 1045 kg ha^{-1} (Gol, 2016). Continuous use of inorganic nutrients may adversely affect the physical and chemical properties of soil and thereby affect the crop yields. In order to

sustain the yield and reduce the dependency on inorganic fertilizer use, conjunctive use of organic manures, biofertilizers and fertilizers is very much essential (Anil Kumar *et al.*, 2003). In India, numerous cow-based fermented products such as *jeevamritham*, *ghanajeevamritham* are being used by the organic practitioners. These products contain macro, micronutrients, essential amino acids, growth promoting factors like IAA, GA and rich in microbial diversity (Sreenivasa *et al.*, 2011). Liquid and solid manures having a variety of beneficial microorganisms may activate biological reactions to restore soil fertility, further acting as plant growth stimulants which can enhance the crop yield and quality. Liquid biofertilizers have the capacity to replace the traditional chemical fertilizers and carrier-based biofertilizers and play a major role in restoring the soil health.

However, lot of measures in terms of technology, government support, subsidies and constructive awareness by well trained technicians are emphasized to increase the usage of liquid biofertilizers among the agrarians (Pavan Kumar and

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Satyanarayana, 2012). Organic farming is gaining importance, which lies in a simple principle of utilizing on-farm resources devoid of agricultural chemicals. Mostly, research on organic production of finger millet is concentrated on the use of FYM, compost, neem cake, etc. Limited research was done on the effect of *ghanajeevamritam* and liquid biofertilizer consortium alone or in combination in finger millet. Hence, the investigation was carried out with an objective to study the effect of organics and liquid biofertilizer consortium on the yield and nutrient uptake of finger millet in southern zone of Andhra Pradesh.

MATERIAL AND METHODS

The experiment was carried out during *Kharif*, 2017 on sandy clay loam soils of wetland, S.V. Agricultural College Farm, Tirupati in a randomized block design with nine treatments, replicated thrice as follows. T₁: Farm yard manure on equal N basis (FYM); T₂: Seed treatment with *ghanajeevamritham* (STG) + soil application of *jeevamritham* (SAJ) @ 500 /ha⁻¹ from sowing to 15 days before harvest with 10 days interval (STG + SAJ); T₃: Neem cake on equal N basis (NC); T₄: Recommended dose of fertilizers : 60-30-20 kg N, P₂O₅, K₂O ha⁻¹ (RDF); T₅: FYM (T₁) + liquid biofertilizer consortium (LBFC); T₆: STG + SAJ (T₂) + LBFC; T₇: Neem cake (T₃) + LBFC; T₈: RDF (T₄) + LBFC; T₉: Control. Liquid Biofertilizer Consortium (LBFC) consisting of phosphorous solubilising bacteria (PSB) + *Azospirillum* + Potash releasing bacteria (KRB) @ 3.75 l ha⁻¹ + Vesicular Arbuscular Mycorrhizae (VAM @ 12.5 kg ha⁻¹) as soil application at the time of transplanting of finger millet. The variety 'saphthagiri' was tested.

RESULTS AND DISCUSSION

Yield

Highest grain yield of finger millet was with STG + SAJ + LBFC (T₆) (1057 kg ha⁻¹) closely followed by RDF + LBFC (T₈) (1029 kg ha⁻¹) which were at par and significantly superior to the rest of

the treatments. FYM + LBFC (T₅) and neem cake + LBFC (T₇) (998 and 997 kg ha⁻¹) were on par with RDF + LBFC (T₈) and significantly superior over rest of the treatments. RDF (T₄), FYM (T₁), neem cake (T₃) and STG + SAJ (T₂), were on par with each other. Lowest grain yield with control (T₉) (Table 1).

Significantly highest grain yield of finger millet with STG + SAJ + LBFC (T₆) and RDF + LBFC (T₈) can be attributed to improvement in growth and yield attributes due to adequate supply of plant nutrients all through the crop period by way of improved microbial activity leading to mineralization of soil organic matter. Uniform and well distributed rainfall of 860.8 mm in 45 rainy days also favoured for quick multiplication of microbial population leading to increased availability and better uptake of nutrients by the crop resulted in highest grain yield. Apoorva *et al.* (2010) reported that application of (STCR fertilizers + FYM @ 10 t ha⁻¹) along with *Azotobacter* + PSB recorded higher grain yield (3741 kg ha⁻¹) which was on par with treatment receiving (STCR fertilizers + FYM @ 10 t ha⁻¹) + PSB (3557.8 kg ha⁻¹) of finger millet. This might be due to increased nutrient availability with conjunctive use of organic and inorganic along with biofertilizer inoculation were responsible for better growth and higher yield.

Combined effect of FYM @ 5 t ha⁻¹ + 75% RDF + bio inoculants (*Azospirillum* + PSB) might have improved vigour and resulted in recording higher values of morphological parameters, which increases the photosynthetic capacity of plant there by increasing the straw yield (30.3 q ha⁻¹) and grain yield (20.4 q ha⁻¹) as reported by Ahiwale *et al.* (2013).

Nutrient uptake

Highest nutrient (nitrogen, phosphorous and potassium) uptake was with RDF + LBFC (T₈), closely followed by RDF (T₄) which were at par and significantly superior to the rest of the treatments. FYM + LBFC (T₅), STG + SAG + LBFC (T₆) and neem cake + LBFC (T₇) were on par with each other and significantly superior over rest of the treatments.

Table 1. Yield and nutrient uptake (kg ha⁻¹) of fingermillet as influenced by organics and biofertilizer consortium

Treatments	Grain yield(kg ha ⁻¹)	N uptake	P uptake	K uptake
T ₁	939	56.4	15.9	79.5
T ₂	901	53.1	13.6	75.2
T ₃	911	58.0	12.9	78.1
T ₄	942	87.2	27.3	103.0
T ₅	998	76.2	22.4	95.9
T ₆	1057	74.9	20.1	93.9
T ₇	997	71.3	20.0	89.5
T ₈	1029	89.1	30.0	106.7
T ₉	667	45.0	9.4	65.8
SEm±	15.63	1.73	1.04	2.12
CD (P ≤ 0.05)	47.2	5.2	3.1	6.4

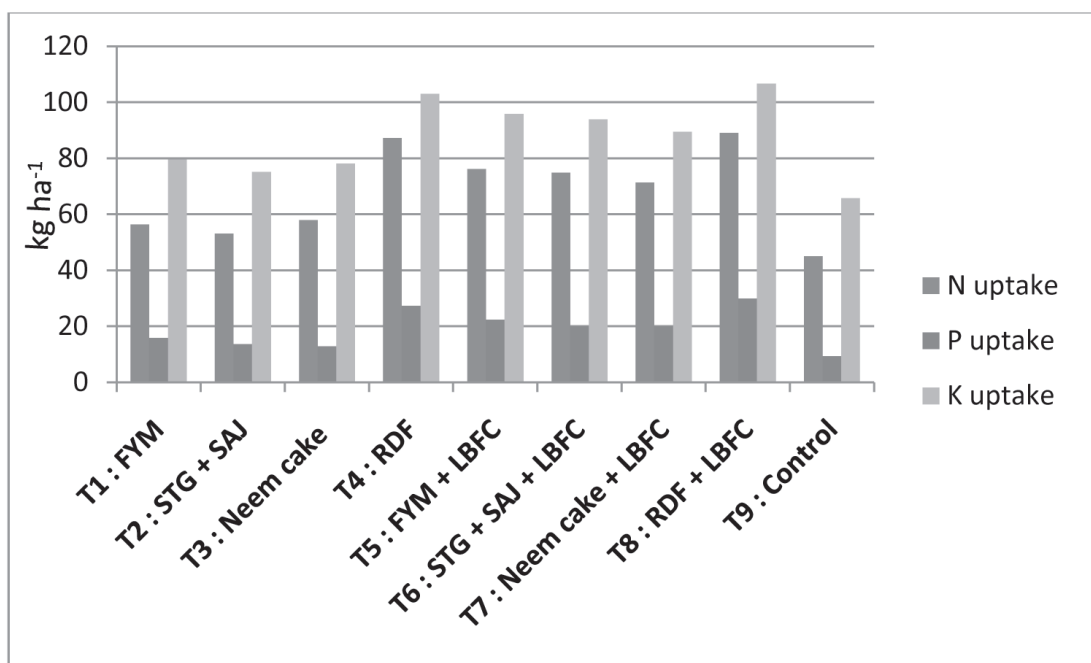


Fig. 1. Nutrient uptake as influenced by organics and bio fertiliser consortium in fingermillet during *Kharif*, 2017

Neem cake (T₃), FYM (T₁) and STG + SAG (T₂) were comparable with each other. Lowest nutrient uptake was recorded with control (T₉).

Highest nutrient (nitrogen, phosphorous and potassium) uptake of fingermillet was with RDF + LBFC (T₈) might be ascribed to the ready availability

of the nutrients, resulting in greater absorption as compared to organic sources. Among the organic sources of nutrients, FYM + LBFC (T_7) and STG + SAJ + LBFC (T_8) resulted in better nutrient uptake. Application of *jeevamritham* at 10 days interval in combination with liquid bio-fertilizer consortium might have improved the soil microbial activity enabling slow and steady release of nutrients for crop growth and development (Table 1). Vajantha *et al.* (2015) reported that N and P uptake was significantly highest in inorganic treated plot (60:40:30 kg NPK ha⁻¹) than organic treated plot (75.2 kg ha⁻¹ and 11.5 kg ha⁻¹, respectively) in finger millet.

Lowest nutrient uptake was recorded with control (T_9) as the crop was grown under nutrient starved condition. For better multiplication of microbes, continuous and well distributed moisture supply through rainfall might have aided and finally resulted in better nutrient uptake.

CONCLUSION

Results revealed that higher grain yield of finger millet with better nutrient uptake could be obtained by seed treatment with *ghanajeevamritham* + soil application of *jeevamritham* @ 500 l ha⁻¹ from sowing to 15 days before harvest with 10 days interval with liquid biofertilizer consortium (STG + SAJ + LBFC). Next best treatment recorded was recommended dose of fertilizers: 60-30-20 kg N, P₂O₅ and K₂O ha⁻¹ with liquid biofertilizer consortium (RDF + LBFC).

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SCHOOL BAGS AND MUSCULOSKELETAL DISCOMFORTS IN NECK AMONG SCHOOL CHILDREN

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ABSTRACT

Non - specific back, neck and shoulder pain among school children are mostly related to over load caused by heavy school bags. Sixty school going children (between 9 and 14 years of age) formed the sample. More than half of the school children (63.33%) felt that there was the occurrence of musculoskeletal discomfort in neck, but that was unnoticed. Only 18.33% of the school children clearly recognized and reported the occurrence of the musculoskeletal discomforts in neck. The frequency of experiencing musculoskeletal discomforts such as pain, numbness, tingling sensation in the neck were moderate in case of 68.33 percent of school children. The respondents who reported high intensity of musculoskeletal discomforts in the neck were 10%. Nearly three-fourth of the respondents (73.33%) reported moderate level of musculoskeletal discomfort in neck. Together 83.33 percent reported moderate to high intensity of musculoskeletal discomforts in neck.

INTRODUCTION

Primary and secondary school children go to school every morning with over stuffed and heavy school bags hanging over their shoulder. The bags are unnecessarily heavy and often larger in size than their backs. The heavier the backpack, the more pressure it exerts on the spinal column and back muscles as the children bend forward in an attempt to support the weight on the back rather than on their shoulders. Thus, heavy school bag will have negative effects on posture and may induce pain in neck, shoulder and back. The peak rate of growth occurs during childhood and puberty. As the child grows, the development of the musculoskeletal system passes through different phases. Particularly, skeletal stature, body weight and height show a constant increase from the age of 5 years onward until approximately upto the age of 10 to 11 years. The rate of growth shows a peak between 11 and 15 years. Body weight increases at a slower rate until the age of 9 to 10 years and afterwards weight increase shows a rapid acceleration as the child enters puberty.

The secondary ossification of vertebrae is not complete until the mid -twenties. In these years the skeletal tissue transforms from cartilage to bone through the process of ossification occurring in several stages. During these years the human body is sensitive and responsive to tension, compression, shear and torsion of the loads that are applied on it (Le Veau and Bernhardt, 1984). External forces, such as heavy backpack loads during school going age may affect the development of normal skeletal alignment (Chansirinukor *et al.*, 2001 and Goodgold *et al.*, 2002). Ram Prasad *et al.* (2010) reported that carrying a back pack weighing 15% of body weight change all the postural angles in preadolescent children in the study conducted with 200 healthy male high school children in Mangalore. Mayank *et al.* (2006) who studied 60 school children in age group 10-15 years of New Delhi reported that loading school children with 10% of body weight would be too heavy for the child to maintain normal cervical and shoulder posture alignment. The improper use of backpack during school going age can lead to muscle imbalance that could turn into chronic back and neck problems later in life. Keeping these in view, the study

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was conducted to know the musculoskeletal discomforts in neck caused by school bags among children of age group 9-14 years.

MATERIAL AND METHODS

The study was conducted in Guntur city during 2017-18 and purposive sampling and random sampling techniques were adopted to select the sample. Three schools who permitted the researcher to collect the data were selected purposively. Since the growth of the vertebral column is continuous between 9-14 years age, respondents were selected from this age group. From each school, 20 school children consisting of 10 boys and 10 girls were selected at random. Thus, out of the total of 60 school children, 30 were girls and remaining 30 were boys. Under the guidance of the medical doctors the musculoskeletal discomfort that can arise due to heavy school bag usage were finalized. The symptoms of musculoskeletal discomforts in neck identified for the study were feeling of pain, feeling of stiffness, appearance of swelling, occurrence of spasms, occurrence of cramps, feeling of numbness, tingling sensations, feeling of pain radiating to head causing head ache, and feeling of pain radiating from neck to shoulder. The independent variable selected

were classified as demographic variables that include age and gender of the subjects, variables that were related to physical and physiological characteristics of the subjects such as height, weight, body mass index, physical fitness index, participation in games and sports and variables related to school bag such as weight of the school bag and school bag usage method.

The data was collected through structured interview schedule. Frequencies and percentages were calculated for all the variables. ANOVA was carried out to find the variation in musculoskeletal discomforts in neck with reference to independent variables. Where 'F' value was found significant, multiple comparison test was carried out to find out the significant mean differences between groups.

RESULTS AND DISCUSSION

The age of the school children selected for the study ranged between 9 and 14 years. Half of the sample were in the age group of 10 to 13 years (Table 1). The mean age of the school children participated in the study was 11.50 years. The deviation in the age of the respondents was 1.72 years.

Table 1. Respondents classification by age

n=60

Age in years	Frequency(N)	Percentage (%)
9 - 10	10	16.67
10 - 13	30	50.00
13- 14	20	33.33
%Total	60	100
Mean	11.50	
SD	1.72	

The results of the study revealed that negligible proportion (3.33%) of the school going children were not conscious about the best method of school bag usage. Half of the sample (51.67%)

frequently adopted best method of school bag usage. One-fifth of the sample (20%) sometimes adopted the best method of school bag usage (Fig. 1).

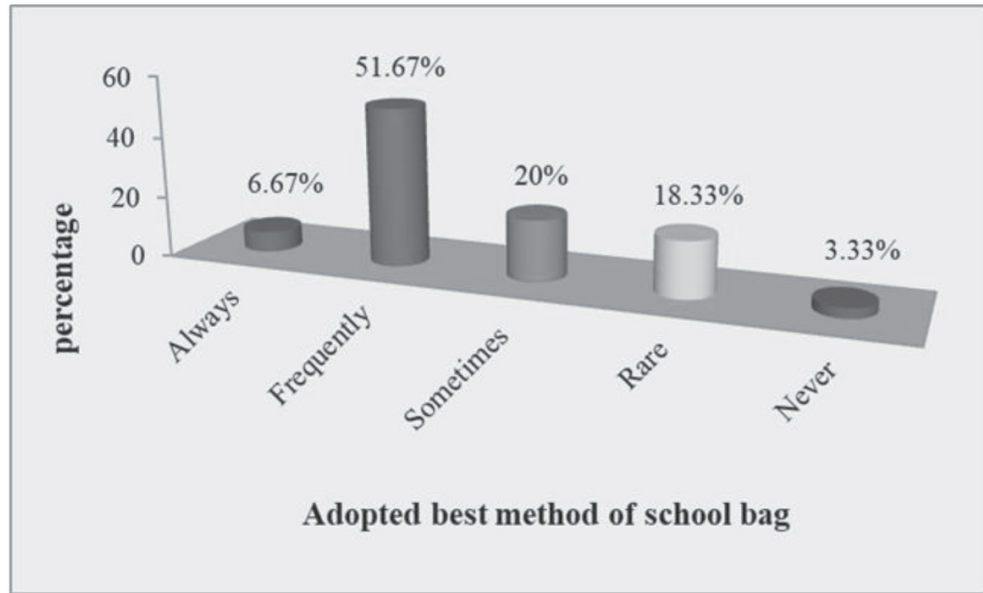


Fig.1. Respondents classification by school bag usage method

One- fifth (21.66%) of the school children were not conscious about best method of school bag carriage. Slightly more than half of the school children (58.34%) were adopting best method of school bag usage (Fig. 1).

Occurrence of musculoskeletal discomforts in neck

The occurrence of musculoskeletal discomfort in neck ranged between 9 and 14 with a

mean score of 11.33 and S.D of 1.47. In case of respondents who scored between 9 and 9.86, the occurrence of musculoskeletal discomforts in neck was relatively low and this group was found to be 18.33%. The respondents who scored between 9.86 and 12.8 were 63.33% and the respondents who scored relatively high score between 12.8 and 14 were 18.33%.

Table 2. Respondents classification by occurrence of musculoskeletal discomforts in neck

n=60

Occurrence of musculoskeletal discomforts in Neck	Frequency(N)	Percentage (%)
Not occurred	11	18.33
Un noticed	38	63.33
Occurred	11	18.33
Total	60	100
Mean	11.33	
SD	1.47	

While indicating the occurrence of musculoskeletal discomfort, the children were unable to report whether they clearly experienced the musculoskeletal discomfort listed or not. Some of the children reported that they cannot confirm that musculoskeletal discomfort occurred. Relatively more number of school children felt there was the occurrence of musculoskeletal discomfort in neck, but that was unnoticed. Only 18.33 percent of the school children reported the occurrence of the musculoskeletal discomfort in neck (Table 2).

Frequency of experiencing musculoskeletal discomforts in neck

The respondents score for frequency of experiencing of musculoskeletal discomforts in neck ranged between 9 and 24. Taking mean and S.D into consideration, the respondents were divided into three groups. The respondents who scored between 9 and 9.86 were grouped as low. Respondents who scored between 16.88 and 24 were grouped as high and respondents who scored in between *i.e.* from 9.86 to 16.88 were grouped as medium. Relatively more number of school children reported the occurrence of musculoskeletal pain in neck more frequently. In case of 13.33 percent of school going children the frequency of occurrence of musculoskeletal discomforts in neck was relatively high (Fig. 2.).

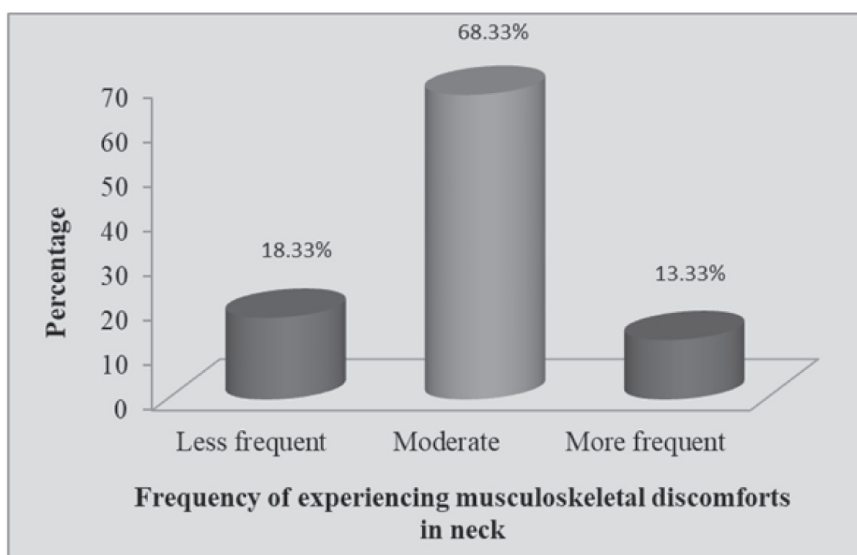


Fig. 2. Respondents classification by frequency of experiencing musculoskeletal discomforts in neck

The frequency of experiencing musculoskeletal discomfort such as pain in the neck, were moderate in case of 68.33 percent of school children (Fig. 2.).

Intensity of musculoskeletal discomforts in neck

The schoolchildren were divided into three groups based on the intensity of musculoskeletal discomforts reported in neck. The respondents who scored between 15.65 and 19 were grouped as high

and who scored between 9 and 10.32 were grouped as low. The respondents whose score was between 10.32 and 15.65 were grouped as moderate. The respondents who reported high intensity of musculoskeletal discomforts in the neck were 10% (Table 3). Nearly three-fourth of the respondents (73.33%) reported moderate musculoskeletal discomfort in neck. Together 83.33 percent reported moderate to high intensity of musculoskeletal pain in neck.

Table 3. Respondents by intensity of musculoskeletal discomforts in neck**(n=60)**

Intensity of musculoskeletal discomforts in Neck	Frequency(N)	Percentage(%)
Low	10	16.67
Medium	44	73.33
High	6	10.00
Total	60	100
Mean	12.98	
SD	2.66	

Table 4. Variation in the occurrence, frequency and intensity of musculoskeletal discomforts in neck and gender of the school children

Variable	Source of variation	df	Sum of square	Mean square	F value	Level of significance
Occurrence of musculoskeletal discomfort	Gender	1	38.40	38.40	25.04**	<.0001
		58	88.93	1.533		
		59	127.33			
Frequency of experiencing musculoskeletal discomfort	Gender	1	176.82	176.82	18.35**	<.0001
		58	558.83	9.635		
		59	735.65			
Intensity of musculoskeletal discomfort	Gender	1	98.82	98.82	17.90**	<.0001
		58	320.17	5.520		
		59	418.98			

NS= non-significant $p < \alpha = 0.01$ significant at 1 percent**, $p < \alpha = 0.05$ significant at 5 percent*

Table 5. Mean comparisons and significant probabilities between gender groups with respect to occurrence, frequency and intensity of musculoskeletal discomforts in neck

Variable	Gender Groups	Mean Scores	Level of significance
Occurrence of musculoskeletal discomfort	Female	12.13 ^a	0.05
	Male	10.53 ^b	
Frequency of experiencing musculoskeletal discomfort	Female	15.06 ^a	0.05
	Male	11.63 ^b	
Intensity of musculoskeletal discomfort	Female	14.26 ^a	0.05
	Male	11.70 ^b	

Note: If letters are different for the mean values then both the means are significantly different at 5% level of significance.

The 'F' value revealed highly significant mean difference at 0.001 level between the gender of the school children and occurrence, frequency and intensity of musculoskeletal discomforts in neck.

According to multiple comparison test, the mean scores earned by female school children with reference to occurrence, frequency and intensity of musculoskeletal discomfort differed significantly at 5% level from the mean scores received by male

school children. Female school children reported the occurrence of musculoskeletal discomforts in the neck more than the male school children. Similarly, the frequency of experiencing musculoskeletal discomfort was reported more by female children. The female children reported high intensity of musculoskeletal discomfort in neck. Female school children were found more sensitive towards the musculoskeletal discomforts in the neck.

Table 6. Variation in the occurrence, frequency and intensity of musculoskeletal discomforts in neck and physical fitness of the school children

Variable	Source of variation	df	Sum of square	Mean square	F value	Level of significance
Occurrence of musculoskeletal discomfort	Physical Fitness	2	13.44	6.7214912	3.36*	0.04
		57	113.890	1.9980763		
		59	127.33			
Frequency of experiencing musculoskeletal discomfort	Physical Fitness	2	52.57	26.2837719	2.19 ^{NS}	0.12
		57	683.08	11.9839027		
		59	735.65			
Intensity of musculoskeletal discomfort	Physical Fitness	2	27.26	13.6298246	1.98 ^{NS}	0.14
		57	391.72	6.8723453		
		59	418.98			

NS= non-significant $p < \alpha = 0.01$ significant at 1 percent**, $p < \alpha = 0.05$ significant at 5 percent*

Table 7. Mean comparisons and significant probabilities between physical fitness groups with respect to occurrence of musculoskeletal discomforts in neck

Variable	Physical fitness Groups	Mean Scores	Level of significance
Occurrence of musculoskeletal discomfort	Low	11.91 ^{ab}	0.05
	Medium	10.97 ^a	
	High	12.00 ^b	

Note: If letters are different for the mean values then the both means are significantly different at 5% level of significance

The probable 'F' value revealed significant variation in the occurrence of musculoskeletal discomforts in neck according to physical fitness of the school children and no significant difference in the frequency and intensity of musculoskeletal discomforts in neck according to physical fitness of the school children.

According to the physical fitness index, the school children were found to be in good physical health. The physical fitness index of the school children and the frequency and intensity of musculoskeletal discomforts experienced by them were found independent. School children with high physical fitness scored more on the occurrence of musculoskeletal discomforts in neck and they differed significantly with school children who unnoticed the occurrence of musculoskeletal discomforts in neck.

CONCLUSION

While indicating the occurrence of musculoskeletal discomfort, the children were unable to identify whether they clearly experienced the musculoskeletal discomforts listed or not. More than half of the school children (63.33%) felt that there was the occurrence of musculoskeletal discomfort in neck, but that was unnoticed. Only 18.33% of the school children clearly recognized and reported the occurrence of the musculoskeletal discomforts in neck. The frequency of experiencing musculoskeletal discomforts such as pain, numbness, tingling sensation in the neck were moderate in case of 68.33 percent of school children. The respondents who reported high intensity of musculoskeletal discomforts in the neck were 10%. Nearly three-fourth of the respondents (73.33%) reported moderate level of musculoskeletal discomfort in neck. Together 83.33

percent reported moderate to high intensity of musculoskeletal discomforts in neck. Highly significant mean difference was observed between the gender of the school children and occurrence, frequency and intensity of musculoskeletal discomforts in neck. There was a significant mean difference between physical fitness of school children and the frequency of experiencing musculoskeletal discomforts in neck.

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MENTAL HEALTH OF CHILDREN RESIDING IN GOVERNMENT INSTITUTION AND SOS MODEL INSTITUTION IN GUNTUR DISTRICT

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ABSTRACT

The study conducted in Guntur district focused on differences between mental health status of children residing in government and Save Our Souls (SOS) model institutions with a total sample 120 (60 from government institution and 60 from SOS model institution). Checklist was used to study general demographic profile of children and mental health status was studied by using Mental Health Battery (MHB). Results revealed that there was a significant difference between government and SOS model institutionalized children's dimensions of mental health such as over-all adjustment (Z value =3.839), autonomy (Z value =7.142), security-insecurity (Z value =3.124) and intelligence (Z value =7.743).

INTRODUCTION

Children are the pillars of the nation. The development of a child depends on his/her family or the institutions they are placed based on their conditions. Institutionalized children are the infants and children who are raised in institutions. They may develop poorly than children who are raised at home and have not been institutionalized. There are different types of orphans who are categorized as "true orphans". Single orphan is a child whose mother or father has died, maternal orphan is a child whose mother has died, paternal orphan is a child whose father has died and double orphan is a child who lost both the parents.

Save Our Souls (SOS) institutions are the non-governmental and non-profit organizations working for the holistic development of parentless children, women and children belonging to vulnerable families. These institutions provides family such as environment for parentless and abandoned children to grow up in.

Maintenance of mental health appears to be most crucial to the maintenance of the other aspects of the human health. It has been noted that the body responds to the way individuals think, feel and act, which is often referred to the "mind/body connection."

When there is a breakdown in mental health, the physical health, as well as the social health tends to suffer more.

Although research was found on mental health status of children residing in institutions and non-institutions but very less research was done on comparisons within the institutionalized children. Hence, the study was proposed to study the mental health status of children residing in government and SOS model institutions.

The study focuses on knowing the mental health status of children residing in Government and SOS model institutions and the strategies in improving mental health of Institutionalized children.

MATERIAL AND METHODS

The study was conducted on a total of 120 respondents (60 from government and 60 from SOS model institution) during March and April of 2018 in Guntur district. The sample consisted of only girls in the age range of 10-14 years. The study was *Ex-post facto* design and the sample was selected by purposive sampling. In Guntur district, a total of 24 government run institutions were found. Kasturba Gandhi *Balika Vidyalaya* (KGBV) institutes located in Atchampeta, Bellamkonda and Krosur of Guntur district were selected. "HEAL" SOS model institution

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Table 1. Distribution of children based on the mental health status (n=120)

Dimensions	Government Institution		SOS Model Institution		Total	
	Frequency (n = 60)	Percentage (%)	Frequency (n = 60)	Percentage (%)	Frequency (n = 60)	Percentage (%)
Socio-economic status						
High	0	0	0	0	0	0
Medium	8	13%	9	15%	17	14%
Low	52	87%	51	85%	103	86%
Emotional stability						
High	17	28%	17	28%	34	28%
Medium	43	72%	43	72%	86	72%
Low	0	0	0	0	0	0
Over-all adjustment						
High	22	37%	44	73%	66	55%
Medium	38	63%	16	27%	54	45%
Low	0	0	0	0	0	0
Autonomy						
High	24	40%	55	92%	79	66%
Medium	36	60%	5	8%	41	34%
Low	0	0	0	0	0	0
Security-Insecurity						
High	34	57%	12	20%	46	38%
Medium	26	43%	48	80%	74	62%
Low	0	0	0	0	0	0
Self – concept						
High	5	8%	4	7%	9	7%
Medium	54	90%	55	91%	109	91%
Low	1	2%	1	2%	2	2%
Intelligence						
High	0	0	3	5%	3	2%
Medium	30	50%	53	88%	83	70%
Low	30	50%	4	7%	34	28%
Mental health status						
Excellent Mental Health	4	7%	8	13%	12	10%
Good Mental Health	49	82%	51	85%	100	83%
Average Mental Health	7	11%	1	2%	8	7%
Poor Mental Health	0	0	0	0	0	0
Very Poor Mental Health	0	0	0	0	0	0

was selected for the study. "HEAL" is the only one SOS model institution in Guntur district which provides food, shelter and other services to the orphan children from birth to 21 years located in Chowdavaram.

General profile of respondents was collected by using questionnaire and mental health status of institutionalized children was measured by using Mental Health Battery (MHB) which was developed by Arun Kumar Singh and Alpana Sen Gupta (2000). The scale consisted of two parts *i.e.*, Section – A and Section – B. Section – A deals with socio-economic status of parents with four indices, and Section – B deals with mental health status of children of age group of 13 to 22 years and section – B is divided into six dimensions consisting of 130 items.

RESULTS AND DISCUSSION

Results on general demographic profile revealed that most of the sample's age ranged between thirteen and fourteen years. Most of the institutionalized children were found to be as paternal orphans (63%) and maternal orphans (47%) in both the institutions. Children who were staying since 7 years were more in both government and SOS model institutions. Reason for institutionalization was found to be semi-orphan in majority of the cases of both the institutions. Majority (90%) of the children from SOS model institution secured more than 75 per cent, whereas, less than half (40%) of the children in government institution secured more than 75 per cent in their academics. More than half of the children (61%) were joined by their own mothers in government institution and 28 per cent of children were joined by their own mothers in SOS model institution.

Dimensions of mental health

Section-A

Socio-economic status (SES)

Majority of children residing in both the institutions government (87%) and SOS model institution (85%) were from low socio-economic status. Remaining (13% children in government and 15% children in SOS model institution) were from average socio-economic status.

Section-B

Emotional stability: The results from Table 2 indicate that equal percentage of children residing in government and SOS model institution had average levels of emotional stability *i.e.*, 72%. Whereas, equal percentage (28%) of children from both the institutions were having high emotional stability. None of them falls under below average levels of emotional stability in both the institutions. The emotional stability levels in children were analyzed based on items that show how these children take criticism in a positive way and maintain balance even in adverse situations.

Over-all adjustment: More than one- third of the children (37%) in government institution and nearly three-fourth of children (73%) in SOS model institution had high over-all adjustment. Two third of children (63%) in government and more than one-fourth (27%) of children from SOS model institution had medium levels of over -all adjustment. None of the children from both the institution were found to be in having low over-all adjustment.

Autonomy: Majority of children (92%) residing in SOS model institution were found in high level of autonomy and 40 per cent of Government institution children fell under high level of autonomy. Nearly two thirds (60%) of the government institution children were having average levels of autonomy and very few (8%) from SOS model institution had average levels of autonomy. None of the children from both the institutions (Government and SOS) were found in low levels of autonomy.

Security-Insecurity: Majority (80%) of children scored medium in terms of security – insecurity

dimension in SOS model institution. Whereas, above one-third (43%) of government institution children scored medium in the same dimension. More than half of children (57%) residing in government institution and less than one-fourth (20%) of children residing in SOS model institution scored high in terms of having secured environment.

Self-concept: Majority (90%) of children from Government institution and SOS model institution (91%) were fallen under medium level of self-concept. Self- concept was found to be high in 8% of government institution children and 7% of SOS model institution. Equal per cent age (2%) of children from both the institutions were fallen under low levels of self-concept.

Intelligence: Majority (88%) of children residing in SOS model institution were found to be in average levels of intelligence. Whereas, half of the children (50%) residing in government institution were found to be in average levels of intelligence and remaining

half found to be in low levels of intelligence. Five per cent of children residing in SOS model institution were found to have high levels of intelligence, whereas, none of the children from government institution were found to have high levels of intelligence.

Mental health status: Mental health was found to be good in majority of the children residing in government institution (82%) and SOS model institution (85%). Excellent mental health was found in seven per cent of government institution and 13% of SOS model institution children. Average mental health was found in 11% of government institution children and two per cent of SOS model institution. None of the children were having poor mental health and very poor mental health in both the institutions.

It is indicated that there was no significant difference in terms of socio-economic status of children residing in government and SOS model institutions (Table 2). An overview of Table 2 shows

Table 2. Differences in mental health status of children residing in government institution and SOS model institution (n=120)

S. No	Dimensions of Mental Health Status	Government Institution (n=60)		SOS model Institution (n=60)		
		Mean	SD	Mean	SD	'Z' Value
I	Section-A					
1.	Socio-economic status	7.30	1.11	7.67	1.48	1.535
II	Section-B					
1.	Emotional stability	9.70	1.36	9.62	1.44	0.3263
2.	Over-all adjustment	26.63	3.28	28.8	2.89	3.839*
3.	Autonomy	10.30	1.11	11.75	1.11	7.142*
4.	Security-insecurity	10.63	2.28	9.53	1.49	3.124*
5.	Self-concept	8.92	1.48	8.43	1.32	1.891
6.	Intelligence	11.15	3.86	16.22	3.28	7.743*
	Over-all Mental health status	182.72	6.75	193.52	6.35	9.026*

* Significant at 0.05% level

that children residing in government and SOS model institution differed significantly in the dimensions of mental health like over-all adjustment, autonomy, security-insecurity and intelligence.

Over-all adjustment: It was observed that children residing in SOS model institution had a high mean score (Z value=3.839) in over-all adjustment compared to the children residing in government institution which infers that children residing in SOS model institution were having better over-all adjustment compared to children residing in SOS model institution. Saraswati and Gaonkar (2008) in their study revealed that majority of the institutional children had unsatisfactory social, emotional and educational adjustment and very few of them had good adjustment. Further, their age and academic performance had significant influence on adjustment. The adjustment of different types of abused children and their different periods of stay in the institution did not differ significantly.

Autonomy: It was evident that there was a significant difference between children residing in government and SOS model institutions favouring children residing in SOS model institution (Z value =7.142). These differences might be due to the presence of fostering environment in SOS model institution.

Security-insecurity: Significant difference implied that the children of government institution scored better (Z value=3.124) in security-insecurity which refers to a high sense of safety, confidence, freedom from fear, apprehension or anxiety particularly with respect to fulfilling the person's present or future needs.

Intelligence: Children from SOS model institution were found to have better intelligence score (Z value=7.743) than children of government institution. This might be because of implementing scheduled time table and due to the presence of evening tuitions in SOS model institutions. Kreppner *et al.* (2007) reported that the poor conditions and deprivation

encountered by children in Romanian 'children's homes' prepared them intellectually and socially disadvantage even after six years. Whereas, children who were placed in family based care before the age of six months have shown significant improvement. Children who were placed later made significant improvements in their development after leaving institutional care, but were still at an intellectual and social behavior disadvantage six years later. An overview of the Table 2 shows that children residing in government and SOS model institution did not differ significantly in the dimensions of mental health like emotional stability and self-concept.

Emotional stability: Though there was no significant difference between government and SOS model institution children related to emotional stability. However, the mean values showed that children from government institution reported better emotional stability compared with the children residing in SOS model institution. The emotional component is usually reflected in increased resentment, sharp, sometimes hysterical reactions to the most innocuous external "irritants". Low emotional stability noticeably complicates a child's communication with the outer world, which can lead to isolation and all sorts of geeky, inappropriate behaviour, up to criminal. Bhat (2014) reported that the orphans and non-orphan secondary school students do not differ significantly in emotional stability. Bhat also found that 34% of adolescent orphans showed low level, 48.66% average level and 17.33% had high level of emotional stability. In comparison, 48% of non-orphans show low level, 36% average and 16% of high level of emotional stability.

Self-concept: It was observed that there was no significant difference in level of self-concept between government and SOS model institutionalized children. Vacaru *et al.* (2017) reported that institution – reared children with disturbed attachment behaviours were likely to have a negative perception of self and one's own competences. The findings

provided an important empirical evidence in support of the notion that disturbed attachment of institutionalized children is associated with poor self-concept and point to a potentially important underlying mechanism through which these effects occur, namely, exploratory behaviours.

Results showed that there was a significant difference between over-all mental health status of children residing in government institution and SOS model institution in Guntur district. Based on mean values we can assume that children residing in SOS model had better mental health compared to children residing in government institution. The results were in line with the study on Karachi SOS conducted by Lassi *et al.* (2011) who reported that the SOS village can be used as a model facility for orphan children. Their philosophy of providing children with a mother, siblings and home can be applied to other orphanages as it has shown some positive impact on the child's mental and social development.

CONCLUSION

Results showed significant difference (Z value= 9.026) between mental health status of children residing in government institution and SOS model institution favouring children residing in SOS model institution.

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IMPACT OF ENTRY POINT ACTIVITIES ON LIFESTYLE CHANGES IN TRIBALS OF WATERSHED PROGRAMME

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ABSTRACT

The study on life style changes has been conducted to assess the impact of the Entry Point Activities (EPA) taken up during the preparatory phase of the *Pradhan Mantri Krishi Sinchai Yojana* (PMKSY) Watershed Programme for selected tribal community in Addangi watershed in Srikakulam District. Preliminary data of the project was obtained through secondary published sources/records of District Watershed Management Agency (DWMA), Watershed Computer Centre (WCC) and State Level Nodal Agency (SLNA) and primary data was collected through Participatory Rural Appraisal (PRA) techniques. Extension of pipe lines for drinking water supply and weighing machines were selected as Entry Point Activities based on location requirements. Income generation activities and life style parameters were considered for analysing the impact of EPA on life style changes in tribal areas. The analysis revealed that there is an increase in the income to some extent directly or indirectly as perceived by selected farmers due to EPA through supply of weighing machines and laying pipelines for drinking water facility which will reflect on their day to day life styles of tribal people. It was also clear that there is marginal change in their life style.

INTRODUCTION

In order to address issues of degradation of natural resources, rainwater runoff, soil erosion, floods, frequent droughts and desertification, reduced forest cover, low agricultural productivity, poor water quantity and quality, and poor access to land and related resources, an integrated watershed management approach is found to be an appropriate solution world over (Paul Bhaskar *et al.*, 2014). In India, the Department of Land Resources (DoLR), under the Ministry of Rural Development (MoRD), has been implementing the Integrated Watershed Management Programme (IWMP) since 2009. In Andhra Pradesh, the Department of Rural Development through the State Level Nodal Agency (SLNA) is implementing 372 watershed projects with an outlay of Rs.1985.16 crores covering an extent of 15.83 lakh ha in five batches from 2009-10 to 2013-2014.

As detailed in the Common Guidelines for Watershed Management Projects (2011), the outcomes are prevention of rain water run-off and soil

loss, regeneration of natural vegetation, rain water harvesting and recharging of the ground water table. This enables multi-cropping and the introduction of diverse agro-based activities which would lead to improved biophysical and socio-economic environment through increased agricultural and allied sector productivity, that help to provide sustainable and alternative livelihoods to watershed communities in the rainfed rural areas. In the *Pradhan Mantri Krishi Sinchai Yojana* (PMKSY) mission, watersheds involvement of primary stakeholders is at the centre of planning, budgeting, implementation, and management of watershed projects. Community organizations such as Watershed Committees (WC), Self help Groups (SHG), User Groups (UG) are closely associated with and accountable to Gram Sabhas in project activities.

The project duration is in the range of 4 years to 7 years depending upon nature of activities spread over 3 distinct phases, viz., preparatory phase (1 to 2 years), works phase (2 to 3 years) and consolidation and withdrawal (1 to 2 years) phase.

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The major objective of preparatory phase is to build appropriate mechanisms for adoption of participatory approach and empowerment of local institutions (WC, SHG, and UG). Watershed Development Team (WDT) will assume a facilitating role during this phase. In this phase, the main activities will include taking up of Entry Point Activities (EPA) in the watershed areas, where there is a provision of 4% of the project funds for the EPA during the preparatory phase.

Role of EPA in Watershed Management:

The EPAs are the project initiation activities that make the village community feel the entry of the watershed project in the village. It helps in confidence building among the village community about the project. Organizing meetings, pasting posters, distributing pamphlets are various means of project initiation activities for creating awareness amongst the village community about watershed project and confidence building, faith development in watershed project. The EPA activities are striking for village community as they address location specific urgent needs. Community get mobilized and the confidence building process will be strengthened.

Points to be considered while selecting EPA

The EPA should be selected in open meetings based on the priority of the village community and it must be approved by the watershed management committee (WC). However, the Watershed Development Team (WDT) members should play a facilitating role in selection of EPA. The EPA works taken up should have a direct impact on village community rather than indirect and time taking impact. EPA should preferably be done in all revenue villages of the project area so that the publicity of entry of project in village can be done in the entire watershed area. EPA should clearly be displayed in the form of wall painting or board. EPA may be a bundle of different activities and not necessarily a single activity for a village. EPA need not be capital intensive. No cost or low cost activities can be taken up.

Entry Point Activities were taken up in all the PMKSY Watershed Projects during the preparatory phase. However, the impact of these EPA activities particularly on the life style changes in the tribal area watersheds were not studied in detail. In this study an effort has been made to assess the impact of EPA in the tribal dominated areas.

Keeping these in view, the study was conducted with the objectives of i) to assess the incremental income generated through EPA in the tribal dominated hilly areas of Srikakulam district of Andhra Pradesh and ii) to analyse the change in life styles of the households in the selected tribal area.

MATERIAL AND METHODS

Srikakulam district of Andhra Pradesh was purposively selected for the study as this is the only district in north coastal area where PMKSY Watershed Programmes have been implemented during 2009-10 to 2012-13. Further, among the 4th batch projects, one project out of three, namely Addangi was selected randomly. The project falls under High Altitude & TRIBAL Area Agro-Climatic Zone in the remote Integrated Tribal Development Authority (ITDA) area. Again in the project, Addangi Micro Watershed (MWS) having 17 habitations is randomly chosen for the analysis where the PMKSY Watershed is in operation from 2012-13 by the District Watershed Management Agency (DWMA), Srikakulam, Andhra Pradesh.

The EPAs taken up were: 1) Supply of four weighing machines in four habitations for weighing agricultural produce with a cost of Rs.0.66/- lakhs; and 2) Extension of pipe lines and water storage tanks for supply of drinking water in five habitations costing Rs.2.15/- lakhs. The location and other details of EPAs are presented in Table 1 and Table 2.

To evaluate the impact of EPA, the study of the Addangi Micro Watershed was conducted, information on before and after EPA has been

collected from the stake holders/beneficiaries by recall technique and the difference in pre and post activity has been attributed as benefit from intervention. The sample size was 32. The limitation of the study is dependence on the recall technique to assess impacts. Preliminary data regarding project were obtained through secondary published sources/ records of DWMA, WCC and SLNA. The primary data was collected through Participatory Rural Appraisal (PRA) techniques such as small group meetings, focussed group discussions etc. from the beneficiaries for the period 2017-18. Paired Student't test was applied for the analysis of data.

1.2. Productivity Enhancement: Though there is a change in yield levels but it is not due to technology adoption but due to the effect of weighing machines provided by SLNA. Earlier in the selected area beneficiaries used to sell their produce to middle men either at regular market or weekly market and received the amount whatever paid by the agents/middle men. They were not aware of the actual weight and simply believed the middle men/ agents. Now because of the availability of weighing machines in the village itself,

Table 1. Location details of weighing machines

S.No.	Habitation	Population	Weekly Market	Regular Market
1	Addangi	195	Seethampet	Seethampet
2	ChinnaRajupuram	120	Gattupalli	Kothaguda
3	Kothaguda	152	Gattupalli	Kothaguda
4	Egumamallalaguda	181	Seethampet	Seethampet

RESULTS AND DISCUSSION

- 1. Income generation variables:** (i) Cropping Pattern (ii) Productivity Enhancement (iii) Income derived from EPA and (iv) Income from off-farm activities
- 2. Life style parameters:** (i) Food Habits (ii) Transport (iii) Clothing (iv) Medical (v) Education, (vi) Drinking Water (vii) Community Activities and (viii) Increased Aspirations

1.1. Cropping Pattern: It is observed that there is no much changes in the cropping pattern of the selected area during pre and post initiation of EPA, except raising of kitchen gardens around 22% as perceived by the selected households and tested statistically which resulted in non-significant 't' value.

they are getting the correct weight of the produces (Table -3) thus minimizing not only the transportation costs but also generating additional income and allowing to go for value chain or post-harvest practices in some of the agricultural and forest crops like paddy, ginger, turmeric, tamarind etc.

The 't' test indicated non-significance between pre and post EPA period on yield levels. Perhaps this might be due to the insufficient time period considered as EPA did not influence the crop yields in the tribal region of the selected area. However, these EPA will influence the yield levels in the long run.

1.3. Income derived from EPA: Due to the availability of weighing machines in their villages, farmers are fetching actual amount for their produce what they deserve. Hitherto, they were deprived of this benefit during the Pre-EPA period. Hence the EPA activities of PMKSY Watershed actually helped the farming community in augmenting their income by providing weighing machines in the study area. Further, because of the availability of drinking water in the tribal villages itself, there is a saving in time which was utilized by working in the farms or raising kitchen gardens in small units or attending to off-farm activities thus generating/realizing additional income as expressed by 88% of the selected beneficiaries (Table 4). It is interesting to note that though there was no significant improvement in physical quantity but in monetary terms, significant results were obtained due to EPA in the study region from pre to post periods.

1.4. Income from off-farm activities: The EPA have created off-farm opportunities in the selected tribal area to an extent of 16%. Before the implementation of EPA, it was observed that one person was completely responsible to fetch water and spending nearly more than 2 hours in a day (Table 5) as it was a difficult job in the hilly areas. The present scenario is changed. At leisure times even in evening or night family members can go and bring the water thus saving time. The time saved in fetching water is being utilized in additional income generation to the household by working both on-farm and off-farm activities. In the study area, the selected beneficiary households are attending to location specific needs such as collection of forest products namely tamarind, dried cashew,

broom grass, 'guggilamu', 'nalla mamidi chekka', etc. as well as processing and preparation of brooms and kitchen gardening thus realizing additional income. Further, these activities would help in doubling the income of farmers in the study region. Paul Bhaskar *et al.* (2014) reported that EPA interventions helped the rural farm and non-farm house holds in increasing their income levels in the tribal areas of Gujarat and Chattisgarh.

2. Life style parameters

The analysis revealed that there is an increase to some extent in incomes directly or indirectly as perceived by selected farmers due to EPA through supply of weighing machines and laying pipelines and providing storage tanks for drinking water which would definitely reflect on their day to day life styles of tribal people. Hence, it is worthwhile to assess whether the EPA really change the life style of beneficiaries in the selected watershed area. This could be analysed through food habits, clothing, health awareness, education, assets building, safe drinking water, community activities, increased aspirations, etc. In order to find out these, an opinion survey was conducted in all the selected habitations with the help of schedules and focussed group discussions and information was obtained for both before and after initiation of EPA (Table 6).

A perusal of the Table 6 indicates that there is marginal increase in case of all the indicators except expenditure on food items, one of the important indicators to judge the life style of a household, where a slight decrease during EPA was noticed. However, after thorough probing, the survey team came to know that the beneficiaries have started consuming more of proteins/pulses during post EPA period as compared to Pre-EPA, thus, realizing the

importance of nutritious food. Though the total expenditure spent was less compared to ex-ante period but they could realize the importance of pulse products. Cherukuri *et al.* (2017) reported that watershed development programmes have increased the consumption of quality foods such as vegetables, fruits, milk, meat etc. due to higher income and health awareness.

Similarly, a two percent (2%) increase on clothing, footwear and assets building and one percent (1%) enhancement of expenditure on education over total income indicated the awareness generated to spend on clothing, and important on education in addition to asset creation of the beneficiaries with the help of additional income realized in the process of development. However, there is a decrease on the expenditure incurred on health to an extent of 2%, which could be attributed to the reduction in drudgery due to drinking of available quality water in the village itself. Hence, there is a reduction on expenditure spent on health problems and this amount has been properly used for asset creation in the form of purchase of cycles, mobiles, agricultural implements, domestic utensils, etc. and education purpose.

An interesting observation was found during the survey that conflicts among the beneficiaries have been decreased and group discussions have increased in the selected tribal area. It was also clear that there is marginal change in their life style though the period considered for analysis was short. As the time progresses these two EPA will show more benefits in the study area in increasing their incomes and ultimately change in life style as they have realized the time loss in fetching water is income loss to the family. The respondents also realised the weight loss in their produce is yield loss. This EPA has built up confidence and

mental strength that they are not going to be deceived any more by the middle men /agents and buyers when marketing their produce.

3. Change in the aspirations and expectations of the community after the EPA

The EPA, a small component of IWMP has brought a considerable change in the attitude of the community. Having realised the benefits, the expectations and aspirations of the watershed community has increased. They want to have roads and transport facilities to the habitations, health care, education, capacity building by way of training. Most of the beneficiaries want to participate in the community activities, decision making, planning and implementation of watershed activities. They are expecting much more positive change in the areas due to implementation of different components of IWMP in the years to come. Finally the selected farmers were asked to express their opinions on the impact of Entry Point Activities in the hilly areas. Accordingly, the collected information was presented and ranked (Table 7).

The elicited information revealed that cent percent farmers expressed their gratitude to SLNA for providing necessary need based location specific EPA in the selected tribal backward region where small holdings are predominant and ranked as the top most item. In order to enhance living standards, infrastructure development is essential which is perceived by 60% of the beneficiaries. Introduction of new crops (54%), more number of demonstrations (46%) and exposure visits (42%) of the selected households opined as important indicators for change in life style which would affect indirectly changes in cropping pattern, productivity of important crops and directly influence the on-farm and off-farm incomes. Still, 32% of the selected households

Table 2. Location details of Pipe line for drinking water

S.No.	Habitation	Population	Cost of pipe line and storage tank (Rs. in lakhs)	Source of drinking water
1	Addangi	195	0.51	Open well
2	ChinnaRajupuram	120	0.53	Open well
3	Kothaguda	152	0.35	Open well
4	Eguvamallalaguda	181	0.39	Open well
5	Dibbaguda	110	0.37	Pond
	Total	758	2.15	

Table 3. Change in productivity enhancement between pre and post EPA

S.No.	Variable	Pre EPA	Post EPA	't' test
1	Productivity Enhancement	Same Yield. No change	Same Yield. No change	NS
		Loss of produce due to Manipulated weighing Machines is 10 to 15 per cent	Weighing on their own machines and cross checking with the buyers	NS

Table 4. Extent of impact of EPA during evaluation period

	Activity	Pre – EPA	Post – EPA	't' test
1	Weighing Machines	Chances of incorrect weighment	Obtaining correct weight of their produce	Significant
2	Extension of pipe lines for drinking water	Insufficient Water	Adequate Water	Significant
		1.1 kms. to 1.5 kms long distance walk to collect water in hilly areas with no proper walk ways even	Water available in the village storage tanks, hence, no long distance walk and minimizing the time in obtaining water	Non-Significant

felt the need of additional pipelines in the study area to cater the requirements of drinking water followed by weighing machines (28%) to obtain

extra income derived from correct weighment for their produce and ranked them as low priority items.

Table 5. Off-farm employment time derived from EPA over ex-ante period

	Activity	Pre EPA	Post-EPA	Time saving/ household
1	Weighing Machine	Produce loss and time loss in weighing and transportation of the produce	Gain in produce weight and minimization of transport time	10-15 days in a year
2	Extension of pipe lines for drinking water	More than 2 hours an average time spent to get water for each household. One individual is completely dedicated to bring water as it is a difficult job	Less than 30 minutes to fetch water. As water is nearby (in the village itself) anybody in the family can do the job	1½ hours One man day

Table 6. Incremental change in life style parameters

S.No	Parameter/Variable	Pre EPA	Post EPA	Change
1	Food expenditure	70% of the total income	Consumption of more nutrients food (68% of total income)	(-) 2%
2	Clothing and foot wear	8% of the total income	10% of the total income	2%
3	Medical	5%	3%	(-) 2%
4	Education	2%	3%	1%
5	Assets building	6%	8%	2%
6	Drinking water	1%	-	-
7	Community activities	Less interactions and more conflicts	Less conflicts and more group discussions	-
8	Drudgery	Lot of drudgery and difficulty to walk on the hilly terrain with a pot full of water	Less drudgery, easy to carry water from nearby storage tank, no long walks	-

Table 7. Change in the aspirations and expectations of the community after the EPA

S. No.	Particulars	Percentage of households	Rank
1	Usefulness of EPA	100	I
2	Infrastructure availability	60	II
3	Willingness for introduction of new crops	54	III
4	Demonstrations	46	IV
5	Exposure visits	42	V
6	Health facilities	33	VI
7	Additional requirement of pipelines for drinking water	32	VII
8	Additional requirement of Weighing Machines	28	VIII

CONCLUSION

The Entry Point Activities (EPA) namely, weighing machines and extension of pipe lines for drinking water supply taken up in the PMKSY watershed projects during the preparatory phase have benefited the tribal dominated community in the hilly areas of North Coastal region of Andhra Pradesh. Weighing machines helped the community to know the correct weight of the produce in the village itself and they are confident that they are not deceived by the middle men. The community expressed 100% satisfaction with the extension of pipe lines and water storage tanks which were found to be useful in reducing the drudgery of getting water from long distance of nearly two kms spending more than 2 hours' time daily by each household. The time and energy saved is being utilized in other income generating activities, thereby increasing the household income. The EPA have brought life style changes of the community in terms of their spending on clothing, education, asset building and other positive community activities.

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MANAGERIAL ACTIVITIES OF AGRIPRENEURS-A STUDY IN ANDHRA PRADESH

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ABSTRACT

The study aimed to assess the managerial activities of agripreneurs in three selected districts of Andhra Pradesh *i.e.* Chittoor, Krishna and Visakhapatnam. From each district, 80 agripreneurs were selected by proportionate random sampling in proportion to the number of chosen enterprises thus, comprising a total sample of 240 agripreneurs. Overall, the study indicated that nearly half of the agripreneurs (47.08%) belonged to medium category of managerial activities followed by high (28.75 %) and low (24.17 %) managerial activities. This might be due to vary nature of the agripreneurs with medium level of understanding about planning, production practices, marketing information and awareness about the new technologies, etc.

INTRODUCTION

Agriculture is the single largest sector having immense potential opportunities for Entrepreneurial activities. Agriculture contributes 16.00 per cent to GDP, 10.00 per cent of total exports and provides employment to 58.40 per cent of country's work force. Nearly 70 per cent (Govt. of India, 2012) of the population is directly or indirectly related to agriculture. Agriculture and allied sectors are considered to be mainstay of the Indian economy because these are important sources of raw materials for industries and they demand for many industrial products particularly fertilizers, pesticides, agriculture implements and a variety of consumer goods.

The share of agriculture in the total value added to the economy, at around 13.2 percent. India's agribusiness market size is estimated Rs. 17.44 trillion (AES, 2014) and it is growing at 9 percent per annum driven by captive domestic demand and export opportunities. Thus, Indian agriculture needs to be converted into agribusiness from subsistence agriculture due to above-mentioned reasons which is only possible through agripreneurship development.

Agripreneurship is considered to be a key factor for promoting economic development,

innovation, competitiveness and job creation. Managerial activities play a pivotal role in successful agri entrepreneurship development (Aparna and Patel, 2012). In the study, managerial activities of agripreneurs were operationalised as the extent to which the existence of selected entrepreneurial activities is perceived by the agripreneurs at a given point in time.

Entrepreneurial management as the practice of taking entrepreneurial knowledge and utilizing it for increasing the effectiveness of agribusiness venturing as well as small and medium-sized businesses (DBIS, 2015). Keeping these in view, the study was conducted with the specific objective of studying the managerial activities of agripreneurs in Andhra Pradesh.

MATERIAL AND METHODS

The study was conducted during 2013-16 in three selected districts of Andhra Pradesh *i.e.* Chittoor, Krishna and Visakhapatnam as these districts have the highest number of agri- linked enterprises among all the districts *i.e.* 10,984 (Annual Report of Commissionerate of Industries, 2015). From the selected districts, 80 agripreneurs have been selected by using proportionate random sampling. A total of 240 agripreneurs selected from 713 agro-

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based enterprises (Table 1) falling under 17 broad categories. *Ex-post facto* research design was used and data was collected through well-structured pre-tested interview schedule.

Scoring and Categorization The scores of seven activities *i.e.* opportunity scanning, business planning, organizing, directing, controlling, marketing and

evaluating were summed up to arrive at a total score of managerial activities of each respondent. The maximum and minimum possible scores of an individual respondent were 150 and 30, respectively. Based on the total scores obtained, the respondents were classified into three categories using mean and standard deviation.

Table 1. Number of agripreneurs under each enterprise

S.No.	Enterprise	Total No. of Enterprises	Number of Enterprises selected
Chittoor district			
1	Fruit processing unit	90	22
2	Groundnut decorticating + rice mills	60	14
3	Tamarind seed <i>dhal</i> unit	25	10
4	Milk chilling+ flavored milk	70	16
5	Silk reeling unit	35	10
6	Food products unit	23	8
Visakhapatnam			
1	Cashew processing unit	22	10
2	Coir making unit	35	17
3	jaggery making unit	60	25
4	Nursery units	16	6
5	Rice+floor mills	36	13
6	Food products unit	20	9
Krishna district			
1	Sea food processing unit	12	5
2	Mango jelly unit	15	7
3	Commercial aqua culture units	120	41
4	Rice+floor mills	50	20
5	Food and dairy units	24	7
	Total	713	240

RESULTS AND DISCUSSION

1. Overall Managerial Activities of Agripreneurs

Managerial activities are the capabilities of an agripreneur to maintain and manage the enterprises for getting higher profitability. The overall analysis indicated that nearly half of the agripreneurs (47.08 %) belonged to medium category followed by 28.75 percent and 24.17 percent belonging to high and low managerial activities category. (Fig. 1)

This might be due to vary nature of the agripreneurs with the medium level of understanding about planning, production practices, opportunity scanning, organizing, directing, controlling, marketing information and awareness about the new technologies and developmental practices to improve the productivity of agro-enterprises. The results were in line with the findings of Sreeram *et al.* (2015) who reported that members of Kudumbashree Neighbourhood Groups (NHGs) in Palakkad district of Kerala had medium level of entrepreneurial behaviour.

Table 2. Distribution of agripreneurs based on their overall managerial activities(n=240)

Category	Chittoor (n=80)		Krishna (n=80)		Visakhapatnam (n=80)		Pooled Sample(n=240)	
	Frequ- ency(F)	Perce- tage(%)	Frequ- ency(F)	Perce- tage(%)	Frequ- ency(F)	Perce- ntage(%)	Frequ- ency(F)	Perce- tage(%)
Low	14	17.50	23	28.75	21	26.25	58	24.17
Medium	42	52.50	38	47.50	33	41.25	113	47.08
High	24	30.00	19	23.75	26	32.50	69	28.75
Total	80	100.00	80	100.00	80	100.00	240	100.00
	Mean =16.39 S.D=9.78		Mean =17.36 S.D=9.86		Mean =17.85 S.D=9.92		Mean =17.02 S.D=9.87	

Distribution of Respondents Based on Different Activities of Managerial Abilities

Opportunity Scanning

The ability of the agripreneur to identify and understand the environment in which he/she operates is opportunity scanning. Table 3 represents that more than half (54.59 per cent) of the agripreneurs had medium opportunity scanning abilities followed by those with high (27.08%) and low (18.33%) opportunity scanning abilities. The ranks obtained to the statements in case of opportunity scanning were- considering the credit facilities (rank I), assessing profitability of enterprise (rank II) and considering the location of the enterprise(rank III)(Table 10).

Agripreneurs were examining the profitability and viability of the enterprise, credit facilities and infrastructure facilities available to them for starting the business *i.e.*, land, water, space, sheds and electricity, *etc.* This might be attributed to the result of medium to high category of opportunity scanning of the agripreneurs. The results are in line with the findings of Ali *et al.* (2011) who studied 480 MBA students and recorded that 57% of the students have positive personal entrepreneurial factors.

Table 3. Distribution of agripreneurs according to their opportunity scanning abilities (n = 240)

Category	Chittoor (n=80)		Krishna (n=80)		Visakhapatnam (n=80)		Pooled Sample(n=240)	
	F	%	F	%	F	%	F	%
Opportunity scanning								
Low	12	15.00	17	21.25	15	18.75	44	18.33
Medium	46	57.50	44	55.00	41	51.25	131	54.59
High	22	27.50	19	23.75	24	30.00	65	27.08
	Mean =11.6 S.D=1.47		Mean =12.73 S.D=2.21		Mean =13.08 S.D=1.80		Mean =12.47 S.D=1.95	

Business Planning

Business planning is the process of making decisions by the agripreneur about enterprise activities in advance to achieve maximum production/sales and profit. Half of the agripreneurs (50.42%) belonged to medium business planning category followed by those to high (27.91%) and low (21.67%) business planning categories (Table 4).

Table 10 illustrates the rank ordering of items of managerial activities of agripreneurs. The obtained ranks to the statements in case of business planning were- considering the source of raw material well in advance(rank I), calculating the total costs

beforehand (rank II), taking adequate care in selecting of crops/animals/products (rank III), considering the past experiences while planning activities (rank IV), keeping an aim before starting enterprise activities (rank V), procuring money before starting enterprise activities (rank VI), anticipating the obstacles while running the enterprise (VII), forecasting sales and costs of the enterprise (rank VIII) and procuring of pollution control certificates before starting the enterprise (rank IX).

Majority of the agripreneurs in three selected districts belonged to medium to high category of business planning. The probable reason might be

Table 4. Distribution of agripreneurs according to their business planning (n = 240)

Category	Chittoor (n=80)		Krishna (n=80)		Visakhapatnam (n=80)		Pooled Sample(n=240)	
	F	%	F	%	F	%	F	%
Business Planning								
Low	13	16.25	14	17.50	25	31.25	52	21.67
Medium	43	53.75	45	56.25	33	41.25	121	50.42
High	24	30.00	21	26.25	22	27.50	67	27.91
	Mean =29.25 S.D=4.93		Mean =34.01 S.D=6.38		Mean =32.98 S.D=6.53		Mean =32.75 S.D=6.11	

due to their secondary school education, high previous work experience, medium level of socioeconomic status and financial behavior and stability in the nature of the enterprise in terms of costs and sales and profitability might have contributed for forecasting the enterprise activities before hand by the agripreneurs. The results are in line with the findings of Bhagyalaxmi *et al.* (2003).

Organizing

Organizing is the arrangement of enterprise work into units, assigning the work based on priorities and arranging the inputs for timely use by the agripreneur. Agripreneurs indicated that majority (57.92%) of them had medium organizing abilities followed by those with high (22.91%) and low (19.17%) organizing activities (Table 5). Table 10 illustrates the rank ordering of items of managerial activities of

agripreneurs. The ranks obtained to the statements in case of organizing were- prioritizing enterprise work according to its importance (rank I), arranging the inputs for their timely use (rank II) and enumerating the enterprise activities beforehand (rank III). Organising is the backbone of management. Without effective organizing abilities, no agripreneur can manage his/her enterprise smoothly. Due to multiple family responsibilities majority of them fell under the medium category of organizing. Birajdar (2014) reported that Management efficiency was influenced by variables, education, experience in cut flower production, participation in trainings, extension participation, organizational participation, economic motivation, scientific orientation and innovative proneness, implying that these factors should be given due importance for increasing management efficiency of growers.

Table 5. Distribution of agripreneurs according to their organizing abilities (n = 240)

Category	Chittoor (n=80)		Krishna (n=80)		Visakhapatnam (n=80)		Pooled Sample(n=240)	
	F	%	F	%	F	%	F	%
Organizing								
Low	12	15.00	21	26.25	13	16.25	46	19.17
Medium	49	61.25	41	51.25	49	61.25	139	57.92
High	19	23.75	18	22.50	18	22.50	55	22.91
	Mean =10.96 S.D=1.56		Mean =12.50 S.D=2.25		Mean =12.92 S.D=1.84		Mean =12.92 S.D=1.84	

Directing

It is the process of taking decisions, supervising, motivating and issuing instructions to making certain operations are originally planned. More than half of the agripreneurs (60.00%) belonged to medium directing activities category followed by those belonging to high (21.25%) and low (18.75%) directing categories (Table 6). Table 10 illustrates the rank ordering of items of managerial activities of

agripreneurs. The ranks obtained to the statements in case of directing were- supervising enterprise activities (rank I), collecting new information related to enterprise. (rank II), taking major decisions about the enterprise (rank III) and motivating the workers to perform enterprise activities effectively (rank IV).

Majority of the agripreneurs in three selected districts belonged to medium to high category of directing abilities. This might be due to the fact that

most of the agripreneurs took joint decisions by having discussion with family members, friends and relatives etc. and they were actively involved in supervision of the business firm. This could be the reason for medium to high directing abilities by the agripreneurs. The results are in line with the findings

of Hema and Premavathi (2013) who observed that medium level of entrepreneurial behaviour was observed among the majority of the rural women respondents (69.17%) followed by high (15.83%) and low levels (15.00%) in Srikakulam district.

Table 6. Distribution of agripreneurs according to their directing abilities (n = 240)

Category	Chittoor (n=80)		Krishna (n=80)		Visakhapatnam (n=80)		Pooled Sample(n=240)	
	F	%	F	%	F	%	F	%
Directing								
Low	12	15.00	23	28.75	10	12.50	45	18.75
Medium	51	63.75	44	55.00	49	61.25	144	60.00
High	17	21.25	13	16.25	21	26.25	51	21.25
	Mean =10.96 S.D=1.56		Mean =12.50 S.D=2.25		Mean =12.92 S.D=1.84		Mean =12.92 S.D=1.84	

Controlling

Controlling is the process of making activities to conform to enterprise requirements and taking any corrective actions if necessary by the agripreneur. All the agripreneurs in three categories put together, 56.67 percent of them had medium controlling

abilities followed by those with low (24.16%) and high (19.17%) controlling abilities (Table 7). Table 10 illustrates the rank order of items of managerial activities of agripreneurs. The ranks obtained to the statements in case of controlling were- ensuring proper utilization of resource available (rank I), trying

Table 7. Distribution of agripreneurs according to their controlling abilities. (n = 240)

Category	Chittoor (n=80)		Krishna (n=80)		Visakhapatnam (n=80)		Pooled Sample(n=240)	
	F	%	F	%	F	%	F	%
Controlling								
Low	11	13.75	24	30.00	23	28.75	58	24.16
Medium	51	63.75	43	53.75	42	52.50	136	56.67
High	18	22.50	13	16.25	15	18.75	46	19.17
	Mean =11.16 S.D=2.00		Mean =12.12 S.D=2.40		Mean =12.41 S.D=2.19		Mean =19.08 S.D=2.05	

to take remedial action when something goes wrong in the enterprise (rank II) and keeping accounts for costs and profits (rank III).

Majority of the agripreneurs belonged to medium to low category of controlling activities. Because of their multiple responsibilities and lack of interest and most of the enterprises are tiny or micro in nature operated with few works and most of them were unable to maintain accounts of costs and sales and lack of knowledge about improved technology leading them to take corrective actions when something goes wrong in the enterprise. The results were in accordance with the findings of Kumar (2002).

Marketing

Marketing is the ability of agripreneur in selling products, which satisfy the needs and wants of the customer at the right time at the right place, and for the right place. Majority (62.08%) of the agripreneurs had medium marketing activities followed by high (20.00 %) and low (17.92%) marketing (Table 8). Table 10 illustrates the rank order of items of managerial activities of agripreneurs. The ranks obtained to the statements in case of marketing were- knowing about competitors and their products (rank I), finding out customers need (rank

II), considering the prices customers prepared to pay for the products before marketing (rank III), getting feedback from customers (rank IV) and involving in sales promotion activities (rank V).

Majority of the agripreneurs belonged to medium to high category of marketing ability. The reason might be that agripreneurs were having medium levels of mass media exposure, information sharing behavior and medium marketing orientation. Therefore, it facilitated them to know the customer's needs, their competitors, prevailing prices and that might have influenced them to undertake sales promotional activities (Thilagam, 2012).

Whereas, in case of Krishna district agripreneurs belonged to medium to low category. This might be due to the fact that most of them were having only primary education and were not able to travel long distances and spend a long time in marketing. Most of the aqua growers hand over their product to middlemen/ commission agents. This might be the reason for medium to low marketing abilities. Ram *et al.* (2013) reported that more than half of the women entrepreneurs have medium decision making ability(62%) and medium managerial ability (63%).

Table 8. Distribution of agripreneurs according to their marketing ability (n = 240)

Category	Chittoor (n=80)		Krishna (n=80)		Visakhapatnam (n=80)		Pooled Sample(n=240)	
	F	%	F	%	F	%	F	%
Marketing								
Low	11	13.75	16	20.00	16	20.00	43	17.92
Medium	53	66.25	49	61.25	47	58.75	149	62.08
High	16	20.00	15	18.75	17	21.25	48	20.00
	Mean =16.41 S.D=2.93		Mean =18.13 S.D=4.53		Mean =18.58 S.D=4.48		Mean =17.71 S.D=4.14	

Evaluation

It is the process of assessing the stability, business condition and future plans of the enterprise, and the self-assessment by the agripreneur. Majority (59.58%) of the agripreneurs in the pooled sample belonged to medium evaluating category followed by those to high (23.34%) and low (19.17%) categories (Table 9). The Table 10 illustrates the rank ordering of items of managerial activities of agripreneurs. The ranks obtained to the statements in case of evaluation were- visualizing future plans of the enterprise (rank I), reviewing the business

condition of the enterprise (rank II) and self-assessment as an entrepreneur (rank III).

Majority of the agripreneurs belonged to medium to a high category of evaluating ability. Due to encouraging economic gains in an enterprise, the majority of the agripreneurs were interested to expand and diversify their enterprise and wanted to undergo training for updated knowledge about the business. Competition among other units of the enterprises within the locality might be also another reason for medium to high evaluating abilities of agripreneurs. The results were in accordance with the findings of Bhagyalaxmi et al. (2003).

Table 9. Distribution of agripreneurs according to their evaluating abilities

(n = 240)

Category	Chittoor (n=80)		Krishna (n=80)		Visakhapatnam (n=80)		Pooled Sample(n=240)	
	F	%	F	%	F	%	F	%
Evaluation								
Low	13	16.25	14	17.50	14	17.50	41	17.08
Medium	52	65.00	44	55.00	47	58.75	143	59.58
High	15	18.75	22	27.50	19	23.75	56	23.34
	Mean =10.31 S.D=1.46		Mean =10.96 S.D=2.11		Mean =11.16 S.D=2.02		Mean =10.81 S.D=1.95	

CONCLUSION

The overall analysis of all the managerial activities revealed that medium level of managerial activities was observed among the majority of the agripreneurs. Based on the findings it is suggested that it is endeavour of all those departments such as Government and other Non-Governmental Organizations who are involved in promoting agro-

based enterprises to give more emphasis on managerial aspects to make them more aware of day to day technological developments and the impact of adoption of those scientific practices on their enterprises and livelihood, through mass awareness campaigns on a large scale which in turn improves their managerial abilities for running the enterprises.

Table 10. Rank order of profile of managerial activities of agripreneurs (n=240)

S.No.	Statement	Always		Frequently		Sometimes		Rarely		Never		TS	MS	Rank
		F	%	F	%	F	%	F	%	F	%			
1. Opportunity Scanning														
1	Assessing profitability of enterprise	96	40	105	43.75	39	16.25	0	0	0	0.00	1017	4.23	II
2	Considering the credit facilities.	89	37.08	128	53.33	23	9.58	0	0	0	0.00	1026	4.27	I
3	Considering the location of the enterprise.	84	35	111	46.25	45	18.75	0	0	0	0.00	999	4.16	III
2. Business Planning														
1	Keeping an aim before starting enterprise activities..	60	25	82	34.16	75	31.25	21	8.75	0	0.00	899	3.74	V
2	Taking adequate care in selecting of crops/animals/products.	82	34.16	76	31.66	42	17.5	32	13.34	0	0.00	928	3.86	III
3	Calculating the total costs before hand	75	31.25	72	30	46	19.16	12	5.00	0	0.00	930	3.87	II
4	Procuring money before starting enterprise activities.	58	24.16	46	19.16	116	48.33	20	8.33	11	4.50	840	3.5	VI
5	Forecasting sales and costs of the enterprise	23	9.58	44	18.33	82	34.16	53	22.08	38	15.83	681	2.83	VIII
6	Considering the past experiences while planning activities.	71	29.58	88	36.66	47	19.58	34	14.16	0	0.00	916	3.81	IV
7	Considering the source of raw material well in advance	92	38.33	85	35.41	63	26.25	0	0	0	0.00	989	4.12	I
8	Anticipating the obstacles while running the enterprise.	23	9.58	76	31.66	67	27.92	42	17.50	32	13.34	736	3.06	VII
9	Procuring of pollution control certificates before starting the enterprise.	32	13.34	10	4.16	13	5.41	27	11.25	158	65.83	451	1.87	IX
3. Organizing														
1	Enumerating the enterprise activities before hand	43	17.92	53	22.08	62	25.83	33	13.75	49	20.41	728	3.03	III
2	Prioritizing enterprise work according to its importance.	41	17.08	96	40	91	37.92	12	5	0	0.00	886	3.69	I
3	Arranging the inputs for their timely use	44	18.33	62	25.83	111	46.25	23	9.58	0	0.00	847	3.52	II

S.No.	Statement	Always		Frequently		Sometimes		Rarely		Never		TS	MS	Rank
		F	%	F	%	F	%	F	%	F	%			
4. Directing														
1	Taking major decisions about the enterprise	31	12.92	34	14.16	127	52.91	48	20.00	0	0.00	768	3.20	III
2	Collecting new information related to enterprise.	54	22.50	62	25.83	86	35.83	38	15.83	0	0	852	3.55	II
3	Supervising enterprise activities.	42	17.5	85	35.41	95	39.58	18	7.50	0	0.00	871	3.62	I
4	Motivating the workers to perform enterprise activities effectively	23	9.58	32	13.34	89	37.08	96	40.00	0	0.00	702	2.92	IV
5. Controlling														
1	Trying to take remedial action when something goes wrong in the enterprise	28	11.66	35	14.58	72	30.00	46	19.16	59	24.58	647	2.69	II
2	Keeping accounts for costs and profits	20	8.33	11	4.58	63	26.25	84	35.00	62	25.83	563	2.34	III
3	Ensuring proper utilization of resource available.	56	23.33	71	29.58	79	32.92	34	14.16	0	0.00	869	3.62	I
6. Marketing														
1	Finding out customers need	32	13.33	54	22.5	79	32.92	46	19.16	29	12.08	734	3.05	II
2	Knowing about competitors and their products	15	6.25	75	31.25	83	34.58	45	18.75	22	9.16	736	3.06	I
3	Considering the prices customers prepared to pay for the products before marketing.	41	17.08	36	15.00	62	25.83	58	24.16	43	17.92	694	2.89	III
4	Involving in sales promotion activities	11	4.58	29	12.08	55	22.92	33	13.75	112	46.67	514	2.14	V
5	Getting feedback from customers	16	6.67	25	10.42	45	18.75	56	23.33	98	40.83	525	2.18	IV
7. Evaluation														
1	Reviewing the business condition of the enterprise	45	18.75	84	35.00	56	23.33	32	13.33	23	9.58	816	3.40	II
2	Visualizing future plans of the enterprise	45	18.75	69	28.75	79	32.91	32	13.33	15	6.25	817	3.41	I
3	Self- assessment as an entrepreneur	35	14.58	43	17.92	71	29.58	34	14.16	57	23.75	685	2.85	III

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FARMERS PERCEPTION TOWARDS UNDERSTANDABILITY AND PREFERENCES ABOUT CONTENTS OF VYAVASAYA PANCHANGAM

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ABSTRACT

Readers personal characteristics, perception towards understandability and preferences about contents of *Vyavasaya Panchangam* (Agriculture Almanac) published by ANGRAU was studied during 2016-17 with a total of 130 farmers. Majority of the respondents were middle aged (47.7%) and were having high school education (32.3%) and above (58.40). With respect to the perception towards understandability, more than half of the respondents (58.5%) had medium perception towards understandability of contents in *Vyavasaya Panchangam*. It could also be observed that majority of the respondents preferred to read information on crop varieties followed by seed to seed operations among the contents published in *Vyavasaya Panchangam*. The independent variables age, education and reading experience have exhibited positive correlation with the understandability.

INTRODUCTION

Higher production in agriculture can only be achieved through the adoption of improved agricultural practices. This could be possible if the research findings are brought to the door step of the end users. A breakthrough in any field of agriculture is not possible without an effective communication support to disseminate the research findings. Speedy dissemination of agricultural information and technological know-how to the farmers is essential for bridging the gap between the agricultural scientists and farming community. The existing extension services are too small to perform their task, so, the print media with its tremendous outreach potential offer the greatest possibility for effective communication of agricultural technology. Farm people are more anxious about the advancement in science and technology to know what is happening in the field of agriculture research (Manjula *et al.*, 2015). The Acharya N.G.Ranga Agricultural University started publishing the *Vyavasaya Panchangam* (Agriculture Almanac) from the year 1969-70 consisting of information on Agriculture and allied sectors in Telugu with an aim to disseminate and popularize the scientific methods of agriculture among

the farming community of Andhra Pradesh state. The printed information in *Vyavasaya Panchangam* remains more permanent; ensure greater accuracy and serves as ready reckoner for farmers and for future reference.

The study has been taken up with the aim to make *Vyavasaya Panchangam* best utilized by farmers by making it easily understandable and by including the most preferred content. The study was undertaken to study the personal characteristics of the respondents and their relationship with understandability of *Vyavasaya Panchangam*; to study the perception of respondents towards understandability of the publication and to elicit the preferences of farmers about the contents published in *Vyavasaya Panchangam*.

MATERIAL AND METHODS

Ex post – facto research design was followed for the study and systematic sampling method was used for selecting the respondents. The study was conducted in 13 districts of Andhra Pradesh during 2016-17. The *Vyavasaya Panchangam* books published in 2016-17, 2015-16 and 2014-15 were considered as basis for the study.

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The readers of these three publications formed the population of the study. The list of readers of the *Vyavasaya Panchangam* was obtained from the District Agricultural Advisory and Transfer of Technology Centres and *Krishi Vigyan Kendras* of concerned district. From each district, list of readers was prepared in an alphabetical manner and every 10th reader was selected as sample for the study. Thus, primarily 10 readers were selected from each of the district and a total of 130 readers were selected as sample.

A set of statements were prepared to elicit the perception of respondents towards understanding various components of the publication with three point continuum of easy to understand, moderate and difficult to understand carrying the scores of three, two and one, respectively. For measuring the preferences, ten contents from the book were listed and the respondents were asked to mark their preferences from 1 to 10. The score of 10 was given for top preference and nine score for preference number 2 and so on. The questionnaire was prepared and mailed to selected sample respondents. The data was collected from unresponsive readers through telephone interview. The results were drawn after processing the data by using mean, standard deviation, frequency, percentage and correlation.

RESULTS AND DISCUSSION

Personal characteristics of the respondents

It was observed from the Table 1 that nearly half (47.69%) of the readers belonged to middle age followed by old (33.85%) and young age (18.46%) groups. The middle aged and old aged respondents were found to be more interested in reading the publication. However, the potential young age respondents are less in number due to lack of experience in farming and they needed to be encouraged in utilising the scientific information either as hard copy or as soft copy through mobile apps to learn various new farming practices. For this to

happen, young age farmers to be trained on creating awareness and utilization of various agriculture and allied sectors related apps in google play store as this age group is more inclined to use of mobiles.

The results in the Table 1 indicated that one-third (32.3%) of the respondents had education up to high school level followed by Intermediate level (24.6%) and under graduation (23.8%). The primary schooling (6.2%) and upper primary schooling respondents are also to be encouraged more to refer *Vyavasaya Panchangam*, since the book is published in simple local language *i.e.* Telugu. The publication should also be sold to poor and marginal literate farmers on subsidised basis by the state government similar to farm inputs.

Regarding farming experience, it could be observed from Table 1 that nearly half of the respondents (49.2%) had medium farming experience followed by low farming experience (38.5%). This may be due to the fact that majority of the respondents belonged to middle aged group and the result is in conformity with the findings of Shireesha *et al.* (2011) who conducted study on the same publication.

The findings also revealed that majority of the respondents are reading *Vyavasaya Panchangam* from one to ten years. Hence, the educated and recently practising agriculture farmers are to be focused to spread the technologies through information materials (Table 1).

2. Perception towards understandability of information

The respondents were classified into three categories based on their perception towards understandability of the information provided in the book using class interval technique. It was observed from Table 2 that more than half of respondents (58.5%) had medium perception towards understandability followed by high (37.7%) and low (3.8%).

Table 1. Personal characteristics of the respondents (n=130)

S.No.	Category	Frequency	Percentage (%)
A. Age			
1	Young age (Below 35 years)	24	18.46
2	Middle age (36 to 50 years)	62	47.69
3	Old age (Above 50 years)	44	33.85
	Total	130	100
B. Education			
1	Primary schooling	8	6.20
2	Upper Primary schooling	4	3.10
3	High school	42	32.30
4	Intermediate	32	24.60
5	Under graduation	31	23.80
6	Post graduation	13	10.00
	Total	130	100
C. Farming Experience			
1	Low experience (2-19 years)	50	38.50
2	Medium experience (20-37 years)	64	49.20
3	High experience (38-55 years)	16	12.30
	Total	130	100
D. Vyavasaya Panchangam reading experience			
1	Low category (1-10 years)	114	87.69
2	Medium category (11-20 years)	14	10.77
3	High category (21-30 years)	2	1.54
	Total	130	100

The item analysis of understandability variable is presented in Table 3. It could be inferred that all the respondents (100.0%) could easily understand the meaning of general words. Majority of the respondents stated that it was easy to understand each sentence (97.7%). About 96.9 % of the respondents reported that it was easy to understand continuity in *Vyavasaya Panchangam*,

meaning of each paragraph and chapter. Majority of the respondents told that it was easy to understand continuity between chapters (96.2%), meaning of content preview as a whole (94.6%), usage of language (89.2%), symptoms of damage by the pests and diseases (82.3%), illustrations (82.3%), and examples given (80.8%). This clearly shows that the book was published in simple, local and informal

Table 2. Distribution of respondents according to their perception towards understandability of information (N=130)

S.No.	Category	Class interval	Frequency	Percentage (%)
1	Low perception	38-51	5	3.80
2	Medium perception	52-65	76	58.50
3	High perception	66-79	49	37.70
Total			130	100

language and also the photos of pests and diseases are printed clearly.

Majority of respondents perceived that technical words (54.6%) in *Vyavasaya Panchangam* were moderately understood. Shireesha *et al.* (2011) also reported similar results. In view of the rapid changes in agricultural technology, new technical terms are frequently being evolved to communicate new technologies. It may be difficult to translate those terms into easy telugu language, but it is compulsory to use at least some of the important technical terms in the regional language, hence attempt should be made by the publishers of *Vyavasaya Panchangam* to translate these new technical terms into simple Telugu terms. It could also be noted from Table 3 that majority of respondents perceived that English words (47.7%) in *Vyavasaya Panchangam* are moderately understood by the respondents. The stated that they are capable of understanding English words which are very popular among Telugu speaking people.

It could be observed from Table 3 that information on compatibility of insecticides, fungicides and Biological agents was difficult (36.9%) and moderately (36.2%) understood by the respondents. In general, farmers use brand names of chemicals, hence, they have less knowledge about technical names and these are given in tables which may not be easily understood by the respondents. Better understanding could be brought out by conducting training programmes on technical names

of insecticides and fungicides. Majority of the respondents revealed that it is difficult to understand information on low cost production technologies (75.4%), weather based agriculture suggestions (70.8%), agricultural information communication tools (69.2%) and information on home science (53.8%). This may be due to the fact that respondents may not have felt information on these items as important, hence awareness programmes could be organised by extension agents to educate farmers on the importance of these new concepts.

3. Relationship between personal characteristics with Understandability of Vyavasaya Panchangam

As seen from the Table 4, there was a positive and significant correlation between age, education and *Vyavasaya Panchangam* reading experience and Understandability of *Vyavasaya Panchangam* by the respondents. Farming experience has exhibited positive and non significant correlation with understandability. The variable education provides the respondent a broader horizon on any innovation. More the education more will be the farmer's outlook towards various sources of information. Because of education, the farmers would perceive the content of *Vyavasaya Panchangam* better thereby increasing the understandability of the technical information given in *Vyavasaya Panchangam*. This might be the reason for positive, high significant relationship between education and understandability.

Table 3. Perception towards understandability of *Vyavasaya Panchangam* (n=130)

S. No.	Items	Easy to understand		Moderate		Difficult	
		F	%	F	%	F	%
1	Meanings of general words	130	100.0	0	0	0	0
2	English words	51	39.2	62	47.7	17	13.1
3	Technical words	52	40.0	71	54.6	7	5.4
4	Illustrations	107	82.3	20	15.4	3	2.3
5	New words	93	71.5	35	26.9	2	1.5
6	Table of contents	99	76.2	26	20.0	5	3.8
7	Dosages of fertilizers	71	54.6	51	39.2	8	6.2
8	Dosages of insecticides	73	56.2	51	39.2	6	4.6
9	Dosages of fungicides	77	59.2	48	36.9	5	3.8
10	Dosages of herbicides	83	63.8	40	30.8	7	5.4
11	Usage of language	116	89.2	11	8.5	3	2.3
12	Continuity in the chapter from one para graph to another paragraph	127	97.7	2	1.5	1	0.8
13	Continuity between the chapters	125	96.2	3	2.3	2	1.5
14	Continuity throughout the panchangam	126	96.9	3	2.3	1	0.8
15	Meaning of each sentence	127	97.7	2	1.5	1	.8
16	Meaning of each paragraph	126	96.9	3	2.3	1	0.8
17	Meaning of each chapter	126	96.9	2	1.5	2	1.5
18	Meaning of the content preview in <i>Vyavasaya Panchangam</i> as a whole	123	94.6	2	1.5	5	3.8
19	Examples given	105	80.8	21	16.2	4	3.1
20	Symptoms of damage by the pests and diseases	107	82.3	19	14.6	4	3.1
21	Information on compatibility of insecticides, fungicides and Biological agents	35	26.9	47	36.2	48	36.9
22	Information on weather based agriculture suggestions	27	20.8	11	8.5	92	70.8
23	Information on low cost production technologies	27	20.8	5	3.8	98	75.4
24	Information on Home science	47	36.2	13	10.0	70	53.8
25	Agricultural Information communication tools	29	22.3	11	8.5	90	69.2

Table 4. Correlation coefficients (r-values) between independent variables and understandability of information in *Vyavasaya Panchangam* (n=130)

S.No.	Independent Variables	Correlation co-efficient of Understandability
1	Age	0.187*
2	Education	0.496**
3	Farming experience	0.004 ^{NS}
4	Publication reading experience	0.190*

* Significant at 5% level of significance; ** Significant at 1% level of significance

4. Preferences of farmers about the contents published in *Vyavasaya Panchangam*

It could be observed that majority of the respondents preferred crop varieties which ranked first as farmers needed first-hand information about the high yielding varieties (Table 5). It was followed by seed to seed operations (II rank) as most of the

respondents need technical information from the starting point of agriculture operations to the end of operations. Plant protection practices were indicated as the next major preference (III rank) among contents published, since, the major problem faced by the farmers in cultivation of crops is of pests and diseases, the findings of which were supported by Shireesha and Jagan Mohan Reddy (2012).

Table 5. Preferences of farmers about the contents published in *Vyavasaya Panchangam* (n = 130)

Content	Total scores	Preference
Crop varieties	1105	I
Seed to seed operations	1022	II
Plant protection practices	778	III
Fertilizer application	748	IV
Zonal / Season wise suitability of the crops	477	V
Irrigation management	401	VI
Organic farming	370	VII
Biological control	266	VIII
Post-harvest technology	132	IX
Information on home science aspects	94	X

CONCLUSION

Majority of the farmers were middle aged (47.7%) with high school and above high school education (90.7%), medium farming experience (49.2%) and were reading *Vyavasaya Panchangam* from one to ten years (87.7%). This implies that educated middle aged farmers who took up agriculture recently as profession are mostly using the publication. It was also found that more than half of the respondents had medium perception towards understandability(58.5%) of information published. Meanings of general words(100%) and continuity of the content was easy to understand(96.9%), while technical words were moderately understood(54.6%) and information on low cost production technologies was found to be difficult to understand(75.4%). The content contributors and extension functionaries must keep in mind the perception of the readers and see that the issues are addressed to improve the understandability of the *Panchangam*. It is also suggested that the District Agricultural Advisory and Transfer of Technology Centres and *Krishi Vigyan Kendras* scientists must provide sufficient orientation and sensitization to the readers about the technical

words, latest technologies included in the *Vyavasaya Panchangam* such as information on weather based agriculture suggestions, information on compatibility of insecticides, fungicides and biological agents, information on low cost production technologies, etc. which were perceived as difficult by majority of respondents.

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NUTRIENT MANAGEMENT IN ELEPHANT FOOT YAM (*Amorphophallus paeoniifolius* DENNST. NICOLSON) WITH VERMICOMPOSTED LEAF LITTER

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The ill effects of chemical farming have led to the promotion of organic farming practices in the country. One of the major bottlenecks encountered in organic nutrition is the non-availability of organic sources in adequate quantities for meeting the nutrient requirements of the crops. Leaf litter is an organic waste available in plenty in tree based ecosystems. The litter fall from the trees can serve as potential sources of nutrient input as these contain considerable amounts of the nutrients necessary for plant growth (Zheng, 2006). The nutrients are made available to the component crops on decomposition. However, natural decomposition and release are reported to take a longer time (Isaac and Nair, 2006). Vermicomposting has in the recent years assumed importance as a viable and eco-friendly method for bio-waste degradation. The paper attempts to assess the growth and yield performance of elephant foot yam (*Amorphophallus paeoniifolius* Dennst. Nicolson) in response to litter compost application as source of nitrogen at varying levels.

The experiment was laid out in Randomised Block Design with five treatments in four replications during March to December, 2014 in an agroforestry system of southern Kerala. The site located at 9.0256° N latitude and 76.8822° E longitude in *Vilakudy panchayat* of Kollam district, experiences a humid tropical climate and the rainfall received during the cropping period (April to December, 2014) was 2500 mm.

The soil was strongly acidic (4.76), high in organic carbon (1.60 %), medium in available phosphorus (16.02 kg ha⁻¹) and low in potassium (143.02 kg ha⁻¹). Litter from the perennial tree components in the agroforestry system were collected and subjected to composting using *Eudrillus eugineae* species of earthworms. Composting was completed in six months and the litter compost after enrichment with the biofertilizer consortium (Plant Growth Promoting Rhizobacteria Mix I) @ 10g kg⁻¹ was used as the nutrient source in elephant foot yam. The recommended dose of 100:50:150 kg NPK ha⁻¹ (KAU, 2011) was followed for the nutrient management. Treatments comprised of 25%, 50%, 75% and 100 per cent substitution of recommended dose of nitrogen (RDN) with enriched litter compost (T₁, T₂, T₃, T₄, respectively) and control, 100 per cent inorganic nutrition (T₅). Corms of 750 g size of variety 'Sree Padma' were planted at a spacing of 90 cm x 90 cm during March, 2014 and mulched with dry leaves. The quantity of the litter compost required for the different treatments was computed based on its nutrient contents (1.31: 0.89:0.27 % NPK). Urea (46% N), Rajphos (20% P₂O₅), Muriate of Potash (60 % K₂O) were the chemical sources used for supplying the remaining quantity of nutrients in different treatments and control. In case of 100 per cent organic nutrition treatment, neem cake, poultry manure and ash were the other sources used. Cultural operations for the crop were completed as per the package of practices recommendations (KAU,

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Table 1. Plant growth characters of elephant foot yam with litter compost application

Treatments	Plant height (cm)		Canopy spread E-W*** (cm)	
	5MAP**	7MAP	5MAP	7MAP
T ₁ (25% N as LC*)	90.95	95.37	136.80	140.90
T ₂ (50% N as LC)	90.17	95.93	145.88	149.28
T ₃ (75% N as LC)	93.08	97.82	131.55	106.93
T ₄ (100% LC)	89.53	95.15	138.55	144.05
T ₅ (100% chemical)	88.35	93.18	138.23	143.22
CD	NS	NS	NS	NS

*LC: Litter Compost

**MAP: Months After Planting

***E-W : East- West

Table 2. Effect of litter compost on the yield attributes and yield in elephant foot yam

Treatments	Average circumference of corm (cm)	Height of corm (cm)	Yield (kg plant ⁻¹)	Yield (t ha ⁻¹)	Benefit -cost ratio
T ₁ (25% N as LC)	71.30	9.05	5.17	21.04	1.96
T ₂ (50% N as LC)	87.30	9.60	7.56	29.58	2.50
T ₃ (75% N as LC)	78.48	9.32	6.48	23.96	2.24
T ₄ (100% LC)	69.65	8.85	7.37	27.92	2.14
T ₅ (100% chemical)	67.33	8.63	6.57	20.21	1.98
CD	NS	NS	1.10	3.51	NS

Table3. Variations in soil microbial counts after elephant foot yam cultivation with litter compost

Treatments	Soil microbial count		
	Actinomycetesx10 ⁴	Bacteriax10 ⁸	Fungix 10 ⁶
T ₁ (25% N as LC)	40.5	33.50	13.00
T ₂ (50% N as LC)	41.0	33.75	13.25
T ₃ (75% N as LC)	38.5	25.25	11.50
T ₄ (100% LC)	46.5	41.25	13.25
T ₅ (100% chemical)	15.25	12.50	8.00
CD	5.34	7.26	2.73

LC: Litter Compost

2011). Biometric observations were recorded at bi-monthly intervals, five months and seven months after planting (MAP) and yield attributes, at harvest. Microbial counts in soil were assessed adopting serial dilution and plate count technique for fungi, bacteria and actinomycetes (Johnson and Curl, 1972). The data collected was statistically analysed to assess the response of the tuber crop to litter compost application. The significance was tested by F test (Gomez and Gomez, 1984). In the cases where the variations were found to be significant, CD values at 5 % level of significance were computed for comparison of means. Student's T test was carried out for comparison.

The results revealed that there was no significant variation in plant height and canopy spread both at 5 MAP and 7 MAP (Table 1). Maximum plant height was recorded in the treatment of 75 per cent substitution of N with the compost (93.08 cm and 97.82 cm at 5 MAP and 7 MAP, respectively). Canopy spread (E-W) at 5 MAP and 7 MAP.

The different levels of N substitution with litter compost did not record any significant influence on the yield attributes (Table 2), nevertheless, corm yield plant⁻¹ were higher in 50 per cent substitution (7.56 kg plant⁻¹) and recorded on par with yield plant⁻¹ at 100 per cent organic nutrition (7.37 kg plant⁻¹). The significant variation in per plant yields might be attributed to the presence of cormels of varying sizes which were not accounted in the corm height and circumference observations. The per hectare corm yields also followed similar trend with 50 percent substitution recording maximum yield (29.58 t ha⁻¹) but on a par with 100 per cent organic (27.92 t ha⁻¹) nutrition, and, significantly superior to all other levels of substitution.

Elephant foot yam has been reported to respond well to organic nutrition (Suja *et al.*, 2006). The better performance at 50 per cent integration would be due to availability of nutrients in the early months from chemical fertilizers as evidenced in the

canopy spread of plants. This would have improved the photosynthetic efficiency contributing to the higher yields in the treatment. Economic analysis also revealed higher B: C ratio (2.50) for 50 per cent substitution (Table 2) indicating that litter compost can be included in the fertilizer package of elephant foot yam at 50 per cent substitution of the recommended dose of N.

The effect of the litter compost applications on soil microbial population (bacteria and actinomycetes) registered maximum counts under 100 per cent organic nutrition while fungi recorded similar count at 50 per cent substitution (Table 3). The floral counts in the 100 per cent chemical fertilizer applied plots were significantly lower and this could be attributed to lesser quantum of organic substrates in soil with chemical fertilizer application which interfered with the proliferation and activities of microbes. Thus, it can be concluded that inclusion of organic nutrient sources would lead to better soil biological activity and hence can result in sustainable production in the long run.

The research experiment has brought to light the potential for use of leaf litters as a nutrient input in elephant foot yam cultivation. Recycling of the litter as vermicompost would ensure productive disposal of the biowastes and can be recommended in elephant foot yam as a nutrient source at 50 per cent substitution of the recommended nitrogen dose along with P and K as chemical fertilisers. Organic nutrition will be economically feasible if the organic manures can be produced *insitu*, within the farm.

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