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RESPONSE OF SOURCES AND LEVELS OF NITROGEN ON POTATO TUBER YIELD THROUGH DRIP FERTIGATION

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ABSTRACT: Potato growing in north Gujarat is most prevalent practice since last so many years. It is important *rabi* crop and gives good amount of money per unit area with best management practice. The experiment was undertaken during *rabi* 2019, 2020 and 2021 at Agricultural Research Station, S. D. Agricultural University, Aseda (Gujarat). The treatments comprised of three levels of source of nitrogen (S): S1 : Urea, S2 : 17-44 + micro nutrient grade III (1.0 %),S3 : WSF 19-19-19 and three levels of nitrogen (N)N1 : 100 % RDN, N2 : 75 % RDN, N3 : 50 % RDN. The experiment was laid out in a factorial randomized block design with three replications. Significantly higher tuber yield were recorded under the WSF 19-19-19 (40.08 t/ha) and 100% (RDN) treatment (37.75 t/ha). Interaction effect showed no significant result. Higher value of net return (₹ 186625/ha) and BCR of 3.00 were recorded under the treatment S1:Urea and 75% nitrogen (145032/ha, BCR of 2.20).

KEYWORDS: *Source of fertilizers, Nnitrogen, Tuber yield, Dry matter, Starch*

INTRODUCTION

Potato (*Solanum tuberosum* L.) is one of most important solanaceous vegetable crops which contributing to the world food requirements and occupied the fourth position after rice, wheat, and maize in production size (Walker *et al.*, 1999). The potato is most important tuber crops in India and grown worldwide. It is produced higher under Uttarpradesh state of about 15892 thousand tones with share of 29% of total country production followed by West Bengal (23.51%), Bihar (17.02%) and Gujarat (3780 thousand tones with shares of 7.05 % of total country production) as per report of NHB 2021-22. The area of potatoes harvested globally generally decreased from 2002 to 2020, before increasing again in 2021. The harvested area in 2021 was approximately 18.13 million hectares, an increase of over seven percent compared to the previous year. (Anonymus, 2023). Several reports compared the organic and synthetic fertilization of potato and revealed that best results are achieved by the last practice in terms of quantity and quality of tubers (Palmer *et al*., 2013; Singh and Lallawmkima, 2018). Overuse of the mineral fertilizers for long period not only makes soils degraded, polluted and less productive but have also posed severe health and environmental problems (Cockburn *et al.*, 2011). Drip irrigation is an effective way to supply water to the roots of plants and save water while maintaining a high yield and excellent product quality. It can easily be used for fertigation through which fertilizer is placed in the active root zone and crop requirements can be met accurately (Li *et al*. 2018). Fertigation also reduces the nutrient loss that would normally occur with the conventional methods of fertilizer application and thus, permits better availability and uptake of nutrients by the crops, leading to higher yield with high fertilizer use efficiency (Fan *et al*. 2020).

MATERIALS AND METHODS

A field experiment was conducted consecutively for three years in *rabi* season

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of 2019, 2020 and 2021 at the Agricultural Research Station, S. D. Agricultural University on the fixed plots. Factorial Randomized complete block design with three replications were used to study the response of sources and levels of nitrogen on potato tuber yield through drip fertigation. The texture of the soil was loamy sand. The soil of the experimental field was low in available N (192 kg/ha), medium in available P (18 kg/ ha) and available K (190.0 kg/ha) and normal in soil reaction (pH 7.58) and electrical conductivity (0.2 mmhos/cm). The treatments comprised of three levels of source of nitrogen (S): S_1 : Urea, S_2 : 17-44 + micro nutrient grade III (1.0 %),S_3 : WSF 19-19-19 and three levels of nitrogen (N)N_1 : 100 % RDN, N_2 : 75 % RDN, N_3 : 50 % RDN. Source of nitrogen applied in five equal split at ten days Intervals in drip irrigation. Entire quantities of phosphorus and potash have been applied as basal in form of SSP and MOP in treatment S_1 and S_2. Soil samples were taken before treatments application and after completion of experiment to know the status of soil nutrient content and effect of nutrient imposition. The data were analyzed statistically by standard analysis of variance (ANOVA). Least significant difference (LSD) test was used to determine whether differences exist between certain comparisons. The probability level for determination of significance was 0.05.

RESULTS AND DISCUSSION

Effect of source and levels of nitrogen on growth and quality of potato

The results shown in table 1 indicated that the effect of different source and levels of nitrogen found non significant on emergence (%), plant height at 50 DAS and number of shoots per plant on pooled basis, However the significantly highest specific gravity starch and dry matter content was recorded in the treatment of S_2: 17-44-00 as source of

Table 1: Effect of source and levels of nitrogen on growth, quality and yield of potato.

Treatments	Emergence (%)	Plant height (cm)	Number of shoots	Dry matter content (%)	Starch content (%)	Specific gravity (kg/m^3)	Total tuber yield (t/ ha)
S. Source of Nitrogen (S)							
S_1 : Urea	93.18	26.54	3.18	15.14	10.27	1.037	35.90
S_2 : 17-44 + micro nutrient grade III (1.0 %)	92.51	27.52	2.97	16.57	10.89	1.050	29.16
S_3 : WSF 19-19-19	92.07	28.47	3.34	15.66	10.32	1.044	40.08
SEm $\pm$	0.47	1.08	0.12	0.09	0.07	0.001	0.77
CD at 5%	NS	NS	NS	0.27	0.19	0.003	2.21
N. Levels of Nitrogen (N)							
N_1 : 100 % RDN	92.66	28.97	3.27	16.28	10.71	1.048	37.75
N_2 : 75 % RDN	92.56	27.38	3.25	15.75	10.43	1.043	35.71
N_3 : 50 % RDN	92.51	26.18	2.96	15.34	10.35	1.039	31.68
SEm $\pm$	0.47	0.57	0.07	0.09	0.07	0.001	0.77
CD at 5%	NS	1.61	NS	0.27	0.19	0.003	2.20
Interaction (S × N)							
S × N	NS	NS	NS	NS	NS	0.006	NS
YxSXN	NS	NS	S.	NS	NS	NS	NS
C.V %	2.65	10.74	7.09	3.09	3.34	0.59	11.50

fertilizers (1.05,10.89 and 16.57 respectively) and 100 % RDN levels of nitrogen (1.048,10.71 and 16.28), while the lowest value found in the S1: urea and N_3: 50% RDN The application of nitrogen through fertigation significantly improve the emergence and growth attributes was reported by Ghiyal and Bhatia 2018 and Yourtchi *et.al* (2013).

The result of interaction found non significant in case of starch and dry matter content while the specific gravity found significant and higher value was recorded under treatment S2N1 and remained at par with all other treatment except S1N2, S1N3 and S3N3. Fertigation with increased levels of nitrogen improve specific gravity of potato tubers reported by Jannat (2010), Kumar *et.al.* (2007), Jenkins and Nelson (1992).

Significantly highest value of specific gravity, starch and dry matter content was recorded in the treatment of S_2: 17-44-00 as source of fertilizers and 100 % RDN levels of nitrogen.

Effect of sources and levels of nitrogen on total tuber yield and haulm yield

The effect of different source and levels of nitrogen on total tuber yield and haulm yield found significant. In case of source of fertilizers, significantly highest total tuber yield (40.08 t/ha) was recorded under the WSF 19-19-19, while among different levels of nitrogen N1 : 100 % RDN recorded significantly higher value of total tuber (37.75t/ha) and remained statistically at par with the treatment N2 : 75 % RDN. The interaction effected remained non significant. Yield increased by the N rate. The soil N application gave higher yield than the zero N and lower than the fustigated treatment found by Mohammad et, al 1999. Seasonal (split) nitrogen management is proposed as a method to improve yield, quality and nitrogen fertilizer use efficiency of in determinant cultivars reported by Ojala et. al. (1990), Ghiyal and Bhatia (2018), Jannat (2010), Fertigation resulted increased in crop yield by 20 to 30 % reported by Sandal *et al*. (2015) and Asrafi *et. al.* (2015), Sharma and Arora (2009), Kumar *et. al.* (2007), Walter *et.al* (2001), Jenkins and Nelson (1992) and Yourtchi *et.al* (2013).

The haulm yield (2702 kg/ha) was recorded significantly highest under the S3 : WSF 19-19-19 in different in case of source of fertilizers, significantly higher haulm yield (2466 kg/ha) was recorded under the N2 : 75 % RDN and remained statistically at par with the treatment N1 : 100 % RDN (2454 kg/ha) . The interaction effect of haulm yield due to different source and levels of nitrogen remained significant, the higher value was recorded under the treatment S3N2(2752kg/ha) and remained at par with the treatment S1N1 (2556kg/ha).

Effect of Source and levels of nitrogen on soil fertility status after harvest of crops

Effect of different source on the PH, organic carbon content, available nitrogen content non significantly affected, while significant result has been recorded in case of available phosphorus and available potash status of soil after harvest of crop. Significantly higher value of available phosphorus and available potash were recorded under the treatment S3: WSF 19-19-19 while lower value was recorded under the treatment of urea. Effect of different levels of nitrogen on pH, OC and available nitrogen and available potash found non significant. Higher value of P_2O_5 was recorded under the treatment of N3: 50 % RDN while lower value was recorded under the treatment N1 : 100 % RDN. The nutrient shows greater availability to crop and increase fertilizers use efficiency due to less leaching loss was reported by Jannat (2010). Asrafi *et.al.* (2015), Guler (2010), Kumar *et. al.* (2007) and Yourtchi *et.al* (2013).

Table 2. Economics of different treatments

Treatments	Tuber yield (t/ha)	Gross realization (₹/ha)	Cost of cultivation (₹/ha)	Net return (₹/ha)	BCR
S. Source of Nitrogen (S)					
S_1 : Urea	35.9	280035	93410	186625	3.00
S_2 : 17-44 + micro nutrient grade III (1.0 %)	29.16	228709	129771	98938	1.77
S_3 : WSF 19-19-19	40.08	313071	185112	127959	1.71
N. Levels of Nitrogen (N)					
N_1 : 100 % RDN	37.75	295032	154190	140842	2.14
N_2 : 75 % RDN	35.71	279516	134484	145032	2.2
N_3 : 50 % RDN	31.68	247267	119620	127647	2.13

Price of inputs (Rs. per kg): Urea@5.35, Potash@19, WSF 19-19-19@100, WSF 17-44-00@35, SSP@8, Tuber@7

Economics

Among the different sources of fertilizers, S1 recorded higher net realization of Rs. 186625/ha and 3.0 BCR value, while in case of levels of fertilizers S2 (75% RDN) recorded higher net realization of Rs.145032/ha and 2.20 BCR value (Table 2). Net income and benefit cost ratio (B:C) indicated ultimately with the quality and yield which was higher with nitrogen fertilizers which conform with the observations of Kumar *et al.* (2007)

CONCLUSION

For fetching the higher tuber yield of potato, when it has been cultivated through drip, it should be fertilized with 25% less nitrogenous fertilizer than the recommended fertilizer through urea in five equal split after 20 days after planting, while entire quantity of phosphorus and potash to be applied as basal at time of planting

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest

ETHICAL STATEMENT

This article does not contain any studies with human participants or animals performed by any of the authors

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