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Short Communication

Influence of Integrated Crop Management on Biochemical Parameters and Field Performance in Mungbean

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Mungbean [*Vigna radiata* (L.) Wilczek] is an important pulse crop having high nutritive value. It contains about 25 per cent protein along with amino acids such as arginine, histidine, lysine and tryptophan etc. It is also considered as a cheap source of protein and other minerals present in it. It has high digestibility and palatability. Since, it is a short duration legume (maturing in 55 to 70 days) fits well into many cropping systems, including rice and sugarcane under both rainfed and irrigated conditions. It increases small farmer's income and improves soil conditions. Among the many factors that regulate crop productivity, quality seed is the most important [1]. As quality seeds ensure vigorous stand establishment, the use of healthy and vigorous seeds is a prerequisite to attain optimum plant stand. The optimum plant density is a pre-requisite for obtaining higher productivity. Plant density affects the plant growth, grain yield and seed quality in mungbean. Plant density may vary with genotype, time of sowing, growing conditions, growing seasons etc. [2]. Understanding the pattern of seed growth is useful in overcoming constraints in harvesting better quality mungbean seeds [3]. Better understanding of the pattern of seed growth is also important as it determines quality of grain legumes [4]. Seed quality is governed not only by the genetic makeup of the crop but also by environmental factors prevailing during the crop growth and at the time of harvest. Environmental factors vary widely over the years and also from season to season. Since mungbean can be grown in different growing seasons, it encounters great variation in environmental conditions at its different growth stages.

The present investigation was conducted at research farm of Genetics and Plant Breeding and laboratories of Department of Seed Science and Technology, CCS Haryana Agricultural University, Hisar during summer and kharif 2015. Seeds of mungbean variety "MH-421" with sixteen treatment combinations; recommended dose of fertilizers (RDF), RDF + Biomix, RDF + $ZnSO_4$, 50% of RDF + $ZnSO_4$, Biomix, recommended weed management (RWM), recommended pest management (RPM), RDF + RWM, RDF + RPM, RWM + RPM, RDF + RWM + RPM, Farm yard manure (FYM), FYM + 50% of RDF, Vermi-compost (VC), VC + 50% of RDF and untreated Control were grown in the field of research area of Genetics and Plant Breeding with the recommended cultural practices and above said treatments. Seed harvested from different treatment combination was evaluated for enzyme activity and field performance *viz.;* electrical conductivity, pH exudate test, dehydrogenase activity test, Catalase test, field emergence index, mean emergence time and seedling establishment in laboratories and field of department of seed science and technology. All these parameters were calculated in three replications of each. Three replicates of 50 normal seeds were soaked in 75 ml of distilled water in a beaker and kept at 25°C [5]. The electrical conductivity was measured after 24 hours with conductivity meter and it was expressed as uS/cm/g.

Three replications of 100 seeds placed in 100 cells of plastic trays, 100 seeds per tray and one seed per cell and 2 ml of distilled water was added to each cell. The seeds were then allowed to imbibe for 30 minutes at 25°C. At the end of imbibition period 25 µl of phenolphthalein solution and 50 µl of sodium carbonate solution were added to soak water in each cell and the trays were agitated to promote mixing. The colour change was noticed. Rosy colour indicated the viable seeds, while no colour change indicated the seeds to be dead and expressed as percentage. DHA test was performed

as per [6]. The representative 25 seeds of each treatment replicated thrice were grounded to pass through a 20 mesh screen. The 200 mg flour was soaked in 5 ml of 0.5% tetrazolium solution having pH 7 at 35°C for 2 hours. Then it was centrifuged at 10,000 rpm for 3 minutes and the supernatant was poured off. Formazan was extracted with 10 ml acetone for 16 hours followed by centrifugation and the absorbance of the solution was determined in a spectrophotometer-169 (Systronics) at 520 nm. The observations were recorded as optical density (OD). The catalase activity was assayed by the method as described by [7] based on the reduction of potassium dichromate to chromic acetate by hydrogen peroxide using the following reagents; 0.1 M hydrogen peroxide (H_2O_2), 0.1 M phosphate buffer (pH 7.0) and Dichromate acetic acid (5% potassium dichromate + glacial acetic acid in the ratio of 1:3). 0.5 ml of H_2O_2 and 1.0 ml of phosphate buffer (pH 7.0) was added in 0.5 ml of enzyme extract in a side mouthed test tube. This was mixed rapidly and then incubated at 37°C for 5 minutes. The test tubes were then taken out and 4 ml of dichromate acetic acid reagent was added. These were then heated for 10 minutes in a boiling water bath. The colour which changed to green due to the formation of chromic acetate after cooling was measured by spectrophotometer at 570 nm. The activity of catalase has been expressed as the amount of enzyme required to bring about a change in absorbance by 0.01 per minute.

Hundred seeds of each sixteen treatments were sown in a factorial randomized block design, with three replications. The number of seedlings emerged were counted on each day from 1st day to 15th day and the Field emergence index (speed of emergence) was calculated as described by [8].

$$\text{Field emergence index} = \frac{\text{No. of seedlings emerged}}{\text{Days of first count}} + \ldots + \frac{\text{No of seedlings emerged}}{\text{Day of final count}}$$

The mean emergence time was calculated for each treatment combination using the formula cited by [9].

$$\text{Mean Emergence Time} = \Sigma nt / \Sigma n$$

Where,

n = number of seeds newly germinated at time 't'

t = days from sowing

Σn = final emergence of seedlings

The seedling establishment was determined by counting the total number of seedlings when the emergence was completed or when there was no further addition in the total emergence.

The results indicated significant difference due to treatments and seasons for electrical conductivity, pH exudate, dehydrogenase activity and catalase activity (Table 1). Results of electrical conductivity indicated significant differences due to treatments and seasons. Among the treatments, RDF+RWM+RPM had lowest amount of seed leachtates (197), (242) for both summer and kharif seasons and was significantly superior to all others. Control (401), (511) was considered as poor because it had high amount of leachtates in both the seasons. The result of seasonal comparison showed that electrical conductivity of all tested treatments were lower in summer season (311) compared to kharif season (371). The pH exudate test showed variation ranging from 78.67% to 96.33%. Among all the treatments, RDF+RWM+RPM showed maximum (96.33%), (93.33%) in summer and kharif season, respectively, whereas control showed the minimum value (85.67%), (78.67%). On comparing the seasons, pH exudates value was found higher in summer season (89.85%) as compared to kharif season (85.75%). The results indicated significant difference due to treatments and seasons for dehydrogenase activity. Among the treatments tested, RDF+RWM+RPM had the highest dehydrogenase activity (0.917), (0.885) in both summer and kharif seasons and the lowest were recorded in control (0.423), (0.313). The sixteen treatments differed significantly from one another. When the seasons were compared, dehydrogenase activity was significantly higher in the seeds obtained from summer season crop with overall mean (0.628) compared to kharif season (0.563). The character, catalase activity showed a variation ranging from 0.195 to 0.513. The highest value was observed in the treatment RDF+RWM+RPM (0.513), (0.488) in summer and kharif harvested crop, respectively and lowest value of catalase activity were recorded in control (0.247), (0.195). Summer season showed superiority with overall mean (0.374) as compared to kharif season (0.324).

The results of field emergence index, mean emergence time and seedling establishment indicated significant differences due to treatments and both the seasons (Table 2). Among the sixteen treatments tested, RDF+

Table 1. Effect of integrated crop management on electrical conductivity, pH exudate, dehydrogenase activity and Catalase activity in mungbean

Treatments	Electrical Conductivity ($\mu S\ cm^{-1}g^{-1}$)		pH Exudate (%)		Dehydrogenase Activity (OD g^{-1} ml^{-1})		Catalase (mg $protein^{-1}$ min^{-1})	
	Summer	*Kharif*	Summer	*Kharif*	Summer	*Kharif*	Summer	*Kharif*
RDF	289	337	88.33(70.00)	88.00(69.72)	0.604	0.624	0.405	0.241
RDF+Biomix	206	246	94.67(76.70)	92.00(73.62)	0.842	0.862	0.498	0.467
RDF+$ZnSO_4$	304	384	91.33(72.89)	87.00(68.85)	0.549	0.577	0.357	0.378
50%RDF+$ZnSO_4$	359	318	88.33(70.03)	84.00(66.40)	0.658	0.415	0.415	0.393
Biomix	327	337	89.67(71.25)	85.00(67.22)	0.588	0.677	0.344	0.332
RWM	334	412	89.33(70.96)	83.33(65.91)	0.565	0.425	0.353	0.288
RPM	346	343	88.33(70.00)	86.00(68.01)	0.540	0.502	0.311	0.277
RDF+RWM	233	324	90.00(71.55)	91.00(72.53)	0.897	0.778	0.475	0.435
RDF+RPM	257	373	92.00(73.56)	88.33(70.00)	0.713	0.752	0.420	0.411
RWM+RPM	373	313	92.33(73.99)	86.67(68.56)	0.689	0.560	0.397	0.376
RDF+RWM+RPM	197	242	96.33(78.95)	93.33(75.07)	0.917	0.885	0.513	0.488
FYM	367	414	87.33(69.13)	81.33(64.38)	0.443	0.378	0.294	0.203
FYM+50%RDF	326	465	87.67(69.42)	82.33(65.12)	0.539	0.400	0.288	0.215
Vermi-compost (VC)	357	477	88.67(70.33)	82.00(64.88)	0.495	0.431	0.367	0.209
VC +50%RDF	312	433	87.67(69.42)	83.00(65.62)	0.590	0.427	0.302	0.274
Control	401	511	85.67(67.74)	78.67(62.47)	0.423	0.313	0.247	0.195
Mean	311	371	89.85(71.62)	85.75(68.02)	0.628	0.563	0.374	0.324
Range	197-401	242-511	67.74-78.95	62.47-75.07	0.423-0.917	0.313-0.885	0.247-0.513	0.195-0.488
CD (p=0.05)	7	6	2.14	1.78	0.009 0.011	0.006	0.06	

Values in parentheses are transformed values

Table 2. Effect of integrated crop management on field emergence index, mean emergence time and seedling establishment in mungbean

Treatments	Field Emergence Index		Mean Emergence Time		Seedling Establishment (%)	
	Summer	*Kharif*	Summer	*Kharif*	Summer	*Kharif*
RDF	11.59	10.03	11.02	11.86	62.33(52.12)	59.33(50.36)
RDF+Biomix	14.55	13.25	8.88	9.55	67.00(54.92)	64.33(53.31)
RDF+$ZnSO_4$	10.73	10.27	11.65	11.56	63.00(52.51)	60.67(51.14)
50%RDF+$ZnSO_4$	12.11	10.49	10.92	12.24	59.33(50.36)	57.00(49.01)
Biomix	12.13	10.94	10.13	12.52	63.00(52.52)	60.67(51.14)
RWM	10.67	9.61	11.57	12.27	61.67(51.73)	58.33(49.78)
RPM	9.55	9.26	11.88	12.55	61.00(51.34)	57.33(49.20)
RDF+RWM	11.30	12.13	10.81	10.14	63.67(52.91)	63.33(52.71)
RDF+RPM	12.58	13.16	9.95	10.61	63.33(52.71)	62.67(52.32)
RWM+RPM	10.78	9.86	11.92	12.47	61.33(51.53)	55.00(47.85)
RDF+RWM+RPM	14.19	11.78	9.13	9.67	65.67(54.11)	63.67(52.91)
FYM	8.87	7.88	12.88	13.88	57.00(49.01)	51.67(45.94)
FYM+50%RDF	9.07	9.26	11.71	13.54	59.00(50.17)	52.33(46.32)
Vermi-compost (VC)	8.95	7.99	12.76	13.69	58.67(49.97)	52.00(46.13)
VC +50%RDF	10.09	8.52	12.18	13.13	60.00(50.75)	56.00(48.43)
Control	8.54	7.13	13.16	14.18	55.00(47.85)	51.00(45.56)
Mean	10.98	10.11	11.28	12.02	61.31(51.53)	57.83(49.51)
Range	8.54-14.55	7.13-13.25	13.16-8.88	9.55-14.18	47.85-54.92	45.56-53.31
CD (p=0.05)	0.34	0.14	0.19	0.08	0.84	0.67

Values in parentheses are transformed values

Biomix had the maximum field emergence index in (14.55), (13.25) and minimum field emergence index was recorded for control (8.54), (7.13) in both summer and kharif seasons. The results of seasonal comparison showed that field emergence index of all the treatments were higher when seeds were obtained from summer season crop as compared to kharif season, with a mean value of 10.98 and 10.11. Mean emergence time showed variation ranging from 8.88 to 14.18. RDF+ Biomix showed the minimum value for mean emergence time (8.88), (9.55) in summer and kharif season, respectively, while control showed the maximum value for mean emergence time (13.16), (14.18). Among the seasons summer season showed the superiority over kharif season with overall mean 11.28 and 12.02, respectively. The seedling establishment showed significant differences due to different treatment combinations and both the seasons. Among the treatment, RDF+ Biomix showed highest seedling establishment (67.00%), (64.33%) followed by RDF+RWM+RPM (65.67%), (63.67%) in both summer and kharif seasons and lowest seedling establishment was recorded in control (55.00%), (51.00%). Comparing the seasons, summer season with a mean value (61.31%) of seedling establishment was significantly superior to kharif season (57.83%). It might be due to higher nutrition content of mother plant reflects on seed quality due to accumulation of higher quantity of protein and carbohydrates in seed and presence of more metabolites helps in resumption of embryonic growth during germination. Other than this, release of enzymes helps in degradation of macromolecules into micromolecules within the seed. The improvement in enzyme activity and field performance may also be due to availability of adequate moisture during vegetative phase and a dry period at crop maturity. Similar results were reported in groundnut [10], mungbean [11], blackgram [12], pea [13], sunflower [14], moth bean [15], soyabean [16] and chilli [17]. Enzyme activity and seedling establishment was found better in summer harvested seed as compared to *kharif* season, it could be due to fact that seed harvested from *kharif* season was under high humidity and low temperature. The variation in enzyme activity between the seasons could be attributed to the better development and better food reserves of seed during summer season. Similar results were also reported in Pigeon pea [18, 19] and mungbean [11, 20, 21].

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