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Response of Nutrients Spray on Seed Yield Parameters in Mungbean (*Vigna radiata* L. Wilczek) During Summer Season

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ABSTRACT

The present investigation was carried out in the research area of the Department of Seed Science and Technology, CCS Haryana Agricultural University, Hisar, Haryana during summer season of 2020 year to access the response of nutrients spray on seed yield parameters in mungbean. The experiment involved foliar application of nutrients i.e., water spray @ 550 L/ha, Urea @ 1%, Urea @ 2%, NPK (18-18-18) @ 1%, NPK (18-18-18) @ 2%, Zinc sulphate + Urea @ 2% + 0.5%, SOP (00-00-52) @ 2% and Urea phosphate (17-44-00) @ 2% along with control (untreated) on two varieties of mungbean (MH-421 and MH-318). The foliar application of nutrients was given at first fortnight after sowing. The harvested seeds were subjected to different test at laboratory viz., germination test, test weight, electrical conductivity. So that we can realize the impact of different nutrients spray on standing crop. The results revealed that, among the treatments superior seed yield parameters (plant height, number of leaves, days to maturity, number of pods per plant, mean emergence time, seedling establishment, field emergence index and seed yield) were recorded, when the foliar application was done with NPK, $ZnSO_4$+Urea and Urea phosphate.

Keywords Mungbean, Foliar application, Nutrients, Seed yield, Field emergence index.

INTRODUCTION

Mungbean (*Vigna radiata* L. Wilczek) informally known as green gram is one of the most important pulse crops, which belongs to family leguminaceae. The varieties of mungbean (MH-421 and MH-318) which are suited for *kharif* and *zaid* crop, offers an excellent opportunity for cultivating short duration crop. The crop is grown in area about 4.42 Mha with the total production of about 2.02 MT of grain with a productivity of about 540 kg/ha (Anonymous 2019). The mungbean is considered as a rich source of proteins (24 %), fat (1.3 %), vitamins and minerals viz., phosphorus (326 mg), calcium (124 mg) and iron (7.3 mg).

The green plant of mungbean serves as nutritious green fodder and feed (Jitender 2017). It also acts as green manuring and cover crop. The crop has nitrogen fixation capacity through *Rhizobium* bacterium which helps in root nodulation. It improves soil fertility due to *Rhizobium* i.e., heterotrophic nitrogen fixing organism (Ashraf and Shanbaz 2003). The area under

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the crop is increasing day by day due to high nutritional value and seed yield. Good quality or healthy seeds will give high yield and high biomass which will increases farmer income and also improves the nutritional value of crop which is used for human consumption and for livestock as well.

Application of nutrient fertilizers either as a basal dose or as spray enhances the yield and quality of the crop. Thakur *et al*. (2017) reported that increase in yield was may be due to increased plant height, number of branches, leaf area and dry matter production. When the plant does not absorb necessary nutrients through root in green gram, then the application of nutrients spray had a major role in cell division and development of meristematic tissues, plant height, photosynthesis, respiration and acceleration of crop physiology (Kachlam *et al*. 2019).

The micronutrient application increased test weight, harvest index and number of pods. Singh *et al*. (2011) concluded that plants with nutrient application gave higher yield than without nutrient application. The seed was subjected to different test at laboratory viz., germination test, test weight, electrical conductivity. So that we can realize the impact of different nutrients spray on standing crop. The application of different nutrients through foliar sprays viz., urea (NH_2CONH_2), Zinc sulphate ($ZnSO_4$), NPK, sulphate of potash (K_2SO_4) and urea phosphate ($CH_7N_2O_5P$) were done to observe the effect of these nutrients on seed quality. Therefore, the present study entitled "Response of nutrients spray on seed yield parameters in mungbean (*Vigna radiata* L. Wilczek) during summer season" was carried out.

MATERIALS AND METHODS

The present investigation was conducted at the laboratory of Department of Seed Science and Technology, Chaudhary Charan Singh Haryana Agricultural University, Hisar during summer 2020. The geographical location of Hisar comes under the Trans-Gangetic plain. It is situated between 29°10' N latitude, 73°43' E longitude and at an altitude of about 210.2 m above mean sea level. The climate of Hisar region is semi-arid with hot and dry desiccating winds accompanied by frequent dust storms of high velocity in summer, severe cold during winter and humid warm during rainy months. The average rainfall varies from 350 to 400 mm and the total rainfall as well as its distribution is subjected to a great variation.

Table 1. List of treatments (nutrients) used as foliar spray.

Treatment	Concentrations	Dose
T_0	Control (untreated)	-
T_1	Water spray	500L/ha
T_2	Urea	@1%
T_3	Urea	@2%
T_4	NPK (18-18-18)	@1%
T_5	NPK (18-18-18)	@2%
T_6	Zinc sulphate + Urea	@2.0+0.5%
T_7	SOP (00-00-52)	@2%
T_8	Urea phosphate (17-44-0)	@2%

The investigation was carried out on freshly harvested seeds (*kharif* 2019) of mungbean varieties viz., MH -318 and MH- 421 which comprised of nine treatments including control (Table 1). The seeds germination was 89% and sowing was done in summer season viz., 2020. These seeds were procured from Department of Seed Science and Technology, Chaudhary Charan Singh Haryana Agricultural University, Hisar.

Experimental design and layout plan: The sowing was done in split plot design with three replications during summer 2020. A total of 54 plots of 9 m^2 were sown at research area of Seed Science and Technology Department of CCS Haryana Agricultural University, Hisar (Table 2). Table 3 shows the physical and bio-

Table 2. Layout of the experiment**.**

		East						
		MH-318			MH-421			
		R1	R2	R3	R1	R2	R3	
North	T_0	T_8	T_0	T_8	T_1	T_0	T_0	South
	T_1	T_7	T_1	T_7	T_0	T_1	T_1	
	T_2	T_6	T_2	T_6	T_5	T_2	T_2	
	T_3	T_5	T_3	T_5	T_6	T_3	T_3	
	T_4	T_3	T_4	T_3	T_4	T_5	T_4	
	T_5	T_4	T_5	T_4	T_3	T_4	T_5	
	T_6	T_2	T_6	T_2	T_7	T_6	T_6	
	T_7	T_1	T_7	T_1	T_2	T_8	T_7	
	T_8	T_0	T_8	T_0	T_8	T_7	T_8	
		West						

Table 3. Physical and chemical properties of soil of the experimental site before sowing.

Sl.No.	Particulars	Results	Method used
1	Soil texture	Sandy loam	Bouyoucos hydrometer method
2	Soil pH value	7.8	Determined in soil: Distilled water suspension (1:2)
3	EC (dS/m)	0.28	
4	Soil organic carbon (%)	0.48	Partial oxidation method
5	Available nitrogen (kg N/ha)	140.8	Alkaline permanganate method
6	Available phosphorus (kg P/ha)	12.5	Sodium bicarbonate method
7	Available potassium (kg K/ha)	246.0	Neutral normal ammonium acetate method

chemical properties of the soil of the experimental site before the sowing.

Cultural practices

The sowing was done with *pora* method on March 16, 2020. In first fortnight of April, different foliar sprays with various doses were done. Just before maturity, field parameters like plant height, number of leaves per plant were recorded. At physiological maturity, number of pods per plants was counted and harvesting was done at harvest maturity. The seeds were collected separately as per different treatments.

The field parameters recorded during the study was:

Plant height (cm)

The five plants were selected randomly from plot and their height was measured with the help of scale in field.

No. of leaves/plant

The five plants which were selected for plant height also used to count number of leaves per plant in field.

Days to maturity

The seeds were sown and the crop was allowed to mature and days were counted up to physiological maturity.

No. of pods/plant

The plants were selected randomly from field and total number of pods was counted.

Field emergence index

The number of seedlings emerged were counted on each day from first day to 15th day and the field emergence index (speed of emergence) were calculated as per method explained by Maguire (1962). The seeds harvested from nine treatments were sown at uniform depth in the research area of Department of Seed Science and Technology, CCS Haryana Agricultural University, Hisar.

The number of seedlings emerged were counted daily up to stable emergence. The field emergence index was estimated as follows.

$$\frac{\text{No. of seedlings emerged}}{1^{st}\text{ day of sowing}} + \text{---} + \frac{\text{No. of seedlings emerged}}{\text{Day of last count } (15^{th})}$$

Mean emergence time

The mean emergence time was recorded of each treatment. All the freshly emerged seeds were recorded on daily basis from 3rd day to 15th day after sowing in each replication. The mean emergence time was calculated by using the formula as described by Roberts and Ellis (1977).

$$MET = \frac{\sum(nD)}{\sum N}$$

Where,
MET = Mean emergence time
n = Number of seeds newly germinated at time 'D'
D = Number of days from the date of sowing
N = Final germination

Seedling establishment (%)

The seedling establishment was determined by count-

ing total number of seedlings when the emergence was completed or when there was no further germination/emergence occurs after 15th day i.e., there was no further addition in the total emerged seedlings.

Seed yield

The foliar sprays were applied at 30 and 50 DAS in both the varieties and are allowed to mature. After harvesting, seed yield were recorded from each plots separately.

Statistical Analysis

Statistical analysis of data collected during the study was done by using the factorial Complete Randomized Design as described by Panse and Sukhatme (1967). All the values described as mean of the replicates with the evaluation of CD at 5% level of significance by using software OPSTAT.

RESULTS AND DISCUSSION

The data recorded during the period of research had been analyzed as per the standard procedure.

Analysis of variance (ANOVA)

The analysis of variance of the spilt plot design of different field parameters was shown in Table 4. The mean sum of square due to varieties, treatments and their interactions were highly significant for most of the characters studied and indicated that the sufficient amount of variation among the varieties and various treatments.

Seed yield (q ha^{-1})

The data indicated in Table 5 showed that seed yield recorded was found significant. The overall mean value with foliar spray of T_6 has given maximum yield (13.50 and 10.86) followed by T_7 (13.38 and 10.78) and T_9 (12.81 and 10.50) over other treatments and control (9.81 and 8.70) in MH-421 and MH-318 varieties respectively. The treatments T_6 and T_8 were found at par in both the varieties. The non-significant difference was recorded with cumulative interaction of both parameters. The mean value of yield was observed 12.23 q/ha and 10.01 q/ha in MH-421 and MH-318 respectively. The significant increase in yield is due to increased leaf area (Ali *et al*. 2008) seed weight (Bybordi and Malakouti 2003) and stem diameter (Malakouti and Tehrani 2005). The results are in line with the findings of Dubey *et al*. (2013) and Jat *et al*. (2015).

Number of leaves

The number of leaves was counted from randomly selected plants (Table 5). The results were significant for both varieties and maximum were observed in T_6 (31.27) followed by T_7 (30.93) over control (26.07) in MH-421. While in MH-318, T_6 (29.67) followed by while T_9 (26.20) over control (20.60). Treatment T_4 is at par in both varieties. Among varieties, MH-421(29.32) performed better than MH-318(24.63) for number of leaves. The increase in number of leaves with supplementation of nutrients was might be attributed to balanced nutrition of the crop. Similar results were showed by Valenciano *et al*. (2010).

Table 4. Analysis of variance for various field parameters in mungbean. **Significant at p=0.01 and p=0.05. *Significant at p=0.05, V=Variety, T=Treatment, V×T = Interaction between variety and treatment, DF= Degree of freedom, FEI= Field emergence index, MET= Mean emergence time (days), SE= Seedling establishment (%), DM= Days to maturity (days).

Source	DF	Seed yield	No. of leaves	No. of pods	Plant height	FEI	MET	SE (%)	DM
V	1	66.893**	296.804**	161.214**	642.063**	578.809**	0.033	28.953**	188.907**
T	8	5.16**	29.987**	32.281**	41.391**	138.366**	1.554**	56.834**	2.25**
VxT	1	0.38	4.73**	11.144**	3.288**	72.408**	0.115	16.207**	1.157**
Error (V)	2	0.248	4.069**	0.826**	1.742**	6.644**	0.17	1.103**	0.685**
Error (T)	32	0.172	1.274**	1.782**	1.372**	4.662**	0.239	4.368**	0.78**

Table 5. Effect of foliar spray on seed yield (q ha^{-1}) and number of leaves. V= Variety, T=Treatment, V × T = Interaction between variety and treatment, CD= Critical difference, SE (m) = Standard error in mean, NS= Non significant.

Treatments		Seed yield (q ha^{-1})				Number of leaves		
		MH-421	MH-318	Mean		MH-421	MH-318	Mean
Control (untreated)	T_1	9.81	8.70	9.26		26.07	20.60	23.33
Water spray	T_2	11.19	9.44	10.32		26.20	20.87	23.53
Urea 1%	T_3	12.26	9.89	11.07		29.70	23.20	26.45
Urea 2%	T_4	12.76	10.39	11.58		30.67	25.93	28.30
NPK (18-18-18) 1%	T_5	12.59	9.94	11.27		30.00	25.53	27.77
NPK (18-18-18) 2%	T_6	13.50	10.86	12.18		31.27	29.67	30.47
$ZnSO_4$+ Urea	T_7	13.38	10.78	12.08		30.93	24.97	27.95
SOP (0-00-52)	T_8	11.78	9.55	10.66		29.07	24.73	26.90
Urea phosphate	T_9	12.81	10.50	11.66		30.00	26.20	28.10
Mean		12.23	10.01			29.32	24.63	
	V	T	T at same level of V	V at same	V	T	T at same level of V	V at same level of T
CD	0.63	0.49	NS	NS	2.54	1.33	2.57	2.86
SE(m) ±	0.10	0.17	0.29	0.25	0.39	0.46	1.17	0.73

Plant height (cm)

The data presented in Table 6 indicated that among treatments maximum mean plant height in MH-421 was found in treatment T_9 (45.20 cm) which was at par with treatment T_6 (43.53 cm) and minimum was found in control (39.20 cm). Similar trend was observed in variety MH-318 for these treatments. Among varieties, overall mean value of MH-421(41.03 cm) was recorded better than MH-318 (34.13 cm). The response of treatments on plant height may be due to stimulatory effect of nutrients on photosynthetic pigments and enzymatic activity which in turn increase vegetative growth of plants. The study is in line with findings of Mounika *et al*. (2018) and Patel (2018).

Number of pods

The number of pods of both varieties in various nutrients spray has been presented in Table 6. The overall mean value of number of pods of mungbean was observed in treatment T_6 (32.47) followed by treatment T_7 (29.54) and treatment T_5 (27.07) as compared to control (26.00) in variety MH-421. The mean value was also maximum in variety MH 318 in treatment T_6 (28.80) followed by treatment T_8 (26.80) as compared

Table 6. Effect of foliar spray on plant height (cm) and number of pods. V= Variety, T=Treatment, V × T = Interaction between variety and treatment, CD= Critical difference, SE (m) = Standard error in mean.

Treatments		Plant height (cm)				Number of pods		
		MH-421	MH-318	Mean		MH-421	MH-318	Mean
Control (untreated)	T_1	39.20	30.93	35.07		26.00	19.47	22.73
Water spray	T_2	39.27	31.20	35.23		24.67	22.60	23.63
Urea 1%	T_3	39.80	31.40	35.60		25.93	21.84	35.60
Urea 2%	T_4	41.87	35.73	38.80		27.60	23.40	25.50
NPK (18-18-18) 1%	T_5	39.27	32.93	36.10		27.07	26.47	26.77
NPK (18-18-18) 2%	T_6	43.53	37.80	40.67		32.47	28.80	30.63
$ZnSO_4$+ Urea	T_7	39.40	31.33	35.37		29.54	21.53	25.54
SOP (0-00-52)	T_8	41.73	37.73	39.73		26.07	26.80	26.43
Urea phosphate	T_9	45.20	38.13	41.67		26.13	23.47	24.80
Mean		41.03	34.13			27.28	23.82	
	V	T	T at same level of V	V at same level of T	V	T	T at same level of V	V at same level of T
CD	1.66	1.38	2.30	2.33	1.15	1.58	2.39	2.31
SE(m) ±	0.25	0.48	0.76	0.69	0.18	0.55	0.53	0.75

to control (19.47). The significant difference was found with in varieties, treatments and cumulative interaction of both parameters. Among varieties, mean value of number of pods was higher in MH-4^{2}1(27.28) than MH-318 (23.82). Jain (2007) stated that the application of Zn significantly increased the number of pods per plant in mothbean.

Field emergence index

The perusal of data in Table 7 showed the impact of foliar spray on emergence index in the field. The effect was found significant for both the varieties i.e., MH-421and MH-318. Field emergence index was recorded highest with T_8 (70.28) treatment and lowest was observed in control (52.83) in MH-421. While in MH-318, the highest value was observed T_8 (75.83) treatment and minimum was observed in control (62.83). Among varieties, mean value was higher in MH-318 (67.23) than MH-421 (60.68). Higher speed of germination might be due to bolder seeds that contain greater metabolites for consumption of embryonic growth during germination as reported by Kumar and Uppar (2007) in moth bean. The results are in close conformity with the findings Anitha *et al*. (2015).

Mean emergence time (days)

The data pertaining to mean emergence time was showed in Table 7. The value of mean emergence time indicated that the maximum improvement in showed in T_8 (70.28) treatment and minimum was observed in control (11.43) in MH-421.The similar trend was seen in other variety i.e., MH-318. The maximum value was recorded in treatment T_7 (9.35) while minimum was observed in control (10.89). Among varieties, overall value of mean emergence time of MH-421 is 10.21 days and MH-318 is 10.25 days. It may be due to the synthesis of seed germinating hormone like gibberellins which triggered the activities of specific enzymes that promoted early germination, such as α -amylase that increase the availability of starch assimilation. The results are in accordance with the findings of Manivasaga *et al*. (2011) and Kaisher *et al*. (2010).

Seedling establishment (%)

The seedling establishment of both varieties in various nutrients spray has been presented in Table 8. The mean value of seedling establishment indicated that maximum was observed in treatment T_7 (67.40) followed by treatment T_5 (66.38) as compared to control (58.06) in variety MH-421. While in MH-318, T_7 treatment performed better followed by T_8 (65.40) as compared to control (55.58). Among varieties, mean value of seedling establishment was higher in MH-421(63.05) than MH-318 (61.59). The results have similarity with findings of Maruti and Paramesh *et al*. (2016).

Table 7. Effect of foliar spray on field emergence index and mean emergence time (days). V= Variety, 3 T=Treatment, V × T = Interaction between variety and treatment, CD= Critical difference, SE (m) = Standard error in mean, NS= Non significant.

Treatments		Field emergence index				Mean emergence time (days)		
		MH-421	MH-318	Mean		MH-421	MH-318	Mean
Control (untreated)	T_1	52.83	62.83	57.83		11.43	10.89	11.16
Water spray	T_2	58.95	66.39	62.67		10.74	10.80	10.77
Urea 1%	T_3	69.10	63.83	66.47		10.16	10.32	10.24
Urea 2%	T_4	54.33	65.16	59.75		10.02	10.18	10.10
NPK (18-18-18) 1%	T_5	58.61	64.22	61.42		10.24	10.54	10.39
NPK (18-18-18) 2%	T_6	69.67	67.55	68.61		9.73	9.83	9.78
$ZnSO_4$+ Urea	T_7	55.89	73.99	64.94		9.62	9.35	9.49
SOP (0-00-52)	T_8	70.28	75.83	73.06		9.74	10.02	9.88
Urea phosphate(17-44-0)	T_9	56.50	65.28	60.89		10.17	10.35	10.26
Mean		60.68	67.23			10.21	10.25	
	V	T	T at same level of V	V at same level of T	V	T	T at same level of V	V at same level of T
CD	3.25	2.55	4.30	4.40	NS	0.58	NS	NS
SE(m) ±	0.50	0.88	1.49	1.28	0.08	0.20	0.24	0.28

Table 8. Effect of foliar spray on seedling establishment (%) and days to maturity. V= Variety, T=Treatment, V × T = Interaction between variety and treatment, CD= Critical difference, SE (m) = Standard error in mean, NS= Non significant.

Treatments		Seedling establishment (%)				Days to maturity		
		MH-421	MH-318	Mean		MH-421	MH-318	Mean
Control (untreated)	T_1	58.06	55.58	56.82		66.33	63.33	64.83
Water spray	T_2	58.29	58.53	58.41		65.33	62.67	64.00
Urea 1%	T_3	65.05	58.69	61.87		65.67	62.67	64.17
Urea 2%	T_4	63.14	60.51	61.83		65.33	61.67	63.50
NPK (18-18-18) 1%	T_5	66.38	60.19	63.29		65.67	61.00	63.33
NPK (18-18-18) 2%	T_6	63.56	65.29	64.42		65.33	60.00	62.67
ZnSO4+ Urea	T_7	67.40	65.88	66.64		65.67	61.33	63.50
SOP (0-00-52)	T_8	63.88	65.40	64.64		65.67	62.33	64.00
Urea phosphate(17-44-0)	T_9	61.72	64.23	62.97		65.33	61.67	63.50
Mean		63.05	61.59			65.59	61.85	
	V	T	T at same level of V	V at same level of T	V	T	T at same level of V	V at same level of T
CD	1.32	2.47	3.63	3.47	1.04	1.04	NS	NS
SE(m) ±	0.20	0.85	0.61	1.16	0.16	0.36	0.48	0.51

Days to maturity (days)

The perusal of data in Table 8 showed the impact of foliar spray on days to maturity of mungbean varieties. The effect was found significant for the varieties and treatments. Days to maturity was observed lowest with T_2, T_4, T_6, and T_9 (65.33) while highest was observed in control (66.33) in MH-421. While in MH-318, the lowest days to maturity was observed in T_6 (60.00) and maximum was observed in control (63.33). Among varieties, mean value was lower in MH-318 (61.85) than MH-421 (65.59). Application of nutrients might have enhanced the availability of nutrients, which resulted in increased photosynthetic activity and translocation of photosynthates from source to sink and this might be the cause of higher growth attributes. The results are in conformity with the findings of Lal *et al*. (2015).

CONCLUSION

The foliar spray with different nutrients significantly improved all the seed yield parameters such as number of leaves, number of pods, seedling establishment (%), plant height (cm), days to maturity and crop produce i.e., seed yield (q ha^{-1}) as compared to control in both varieties (MH 318 and MH 421) of mungbean. For seed yield, the spray of NPK (18-18-18) @ 2%, $ZnSO_4$+Urea @ 0.5 + 2 % and Urea phosphate @ 2 % has similar effect on both the varieties of mungbean viz., MH-421, MH-318.

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