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Response of Nutrients Spray on Physiological and Biochemical Aspects of Seed Quality in Mungbean [*Vigna radiata* (L.) Wilczek] during Summer

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ABSTRACT

Background: Mungbean is considered as one of the most important pulse crop that belongs to the family of leguminosae. Seed is a basic input and vital element that plays a crucial role in agriculture production as well as in the national economy. Good quality seed gives high yield and higher biomass, which ultimately increases farmers' income.

Methods: The investigation was performed at the laboratory and research farm of Department of Seed Science and Technology, CCS HAU, Hisar during the summer season 2020, which consists of foliar application of nutrients at the first fortnight after sowing of the crop *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 mungbean varieties (MH-421 and MH-318). The harvested seeds were evaluated for physiological and biochemical parameters of seed quality.

Result: The seed quality parameters (physiological parameters *i.e.,* germination, seedling length, seedling dry weight, vigour indices and biochemical parameters *i.e.,* peroxidase, superoxidase and dehydrogenase activity) were recorded higher when the foliar application of NPK (18-18-18) @ 2% was done in both the varieties.

Key words: Enzyme activity, Foliar application, Germination, Mungbean, Nutrients, Seed quality.

INTRODUCTION

Mungbean [*Vigna radiata* (L.) Wilczek] is colloquially known as green gram. It is considered one of the most important pulse crop that belong to the leguminosae family. It is a self-pollinated crop and is grown in *kharif* as well as in the summer season. It occupies a 4.42 M ha area with a production of 2.02 MT and a productivity of 540 kg/ha (Anonymous, 2019). It is an important food legume with a rich source of proteins (24%), fat (1.3%), vitamins and minerals like phosphorus (326 mg), calcium (124 mg), iron (7.3 mg). The green plant serves as nutritious green fodder and feed (Jitender, 2017). The crop has nitrogen fixation capability due to *Rhizobium* which improves soil fertility (Ashraf and Shanbaz, 2003). The area under the crop is increasing day by day due to its high nutritional value and seed yield (Gupta and Partap 2016).

Seed is a basic input and vital element that plays a crucial role in agriculture production as well as in the national economy. Good quality seeds will give high yield and high biomass, which will increase farmers' income and nutritional value of their crop. Application of nutrient fertilizers as a basal dose or spray enhances the yield and quality of the crop. Thakur *et al.* (2017) reported that the increase in the yield 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 roots in green-gram, then foliar application plays a major role in cell division and development of meristematic tissues, plant height, photosynthesis, respiration and acceleration of crop physiology (Kachlam *et al.,* 2019). Singh *et al.* (2011) concluded that plants with nutrient application gave higher yields. Therefore, the present study entitled "Response of nutrients spray on physiological and biochemical aspects of seed quality in mungbean [*Vigna radiata* (L.) Wilczek] during summer" was carried out.

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MATERIALS AND METHODS

The present investigation was conducted at the Laboratory of the Department of SST, Chaudhary Charan Singh Haryana Agricultural University Hisar during summer 2020. Hisar's geographical location falls under the Trans-Gangetic plain. It is situated between 29°10′ N latitude, 73°43′ E longitude at an altitude of about 210.2 m above mean sea level. The study was carried out on freshly harvested (*Kharif* 2019) seeds of mungbean varieties *viz*., MH -318 and MH- 421, procured from the same university. The initial germination percentage was 94 per cent and sowing was done in furrows with the help of wooden structures at a depth of 5 cm in plots of 3×3 m in March 2020. The following nutrients were used as foliar spray:

Treatments	Concentrations	Dose
T0	Control (untreated)	-
T1	Water spray	500L/ha
T2	Urea	@1%
T3	Urea	@2%
T4	NPK (18-18-18)	@1%
T5	NPK (18-18-18)	@2%
T6	Zinc sulphate+ Urea	@2.0 + 0.5%
T7	SOP (00-00-52)	@2%
T8	Urea phosphate (17-44-0)	@2%

The foliar sprays of various doses were done on first fortnight of April, 2020. The seeds were collected plot wise and were analyzed for seed quality in the laboratory.

Standard germination (%)

Four hundred seeds of each treatment were placed in three replications in between the germination paper and placed in germinators at 25±1°C. The germination was checked on 8th day and normal seedlings were considered for per cent germination (ISTA, 2015).

• When no hard seed:

Seed germination (%) =

$$\frac{\text{Number of seeds germinated}}{\text{Total number of seeds placed for germination}} \times 100$$

• When hard seed is there:

Seed germination (%)=

$$\frac{\text{Number of seeds germinated + Hard seeds}}{\text{Total number of seeds placed for germination}} \times 100$$

Seedling length (cm)

Ten normal seedlings from each replication were selected randomly to measure root and shoot lengths to get the average seedling length.

Seedling dry weight (mg)

Ten normal seedlings were selected randomly from each replication of the standard germination test and were dried in a hot air oven for 3 days (72 h) at 80±1°C. The dried seedlings were weighed and the average seedling dry weight of each treatment was calculated.

Seedling vigour indices

The vigour indices were calculated by the standard method suggested by Abdul-Baki and Anderson (1973):

Vigour index-I = Standard germination (%) × Average seedling length (cm)

Vigour index-II = Standard germination (%) × Average seedling dry weight (mg).

Biochemical parameters

A dehydrogenase activity (DHA) test was performed as per the method given by Kittock and Law (1968). Superoxide dismutase activity (SOD) of the seeds was recorded by the method given by Giannopolitis and Ries (1977). Catalase activity (CAT) was measured by a slightly modified method of Sinha (1972). Peroxidase activity (POD) was estimated by determining the rate of guaiacol oxidation in the presence of H_2O_2 at 470 nm (Rao *et al*., 1998).

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 (1985). All the values are described as the mean of the replicates with the evaluation of CD at a 5 per cent level of significance by using the software OPSTAT.

RESULTS AND DISCUSSION

Germination

Fig 1 indicates the overall mean value of germination percentage. Which showed maximum germination was recorded in treatment T6 (86.00) followed by treatment T4 (85.67) as compared to control (78.33) in variety MH-421 (Fig 1). The mean value of variety MH 318 was also highest in treatment T6 (86.33) followed by treatment T4 (85.67) as compared to control T1 (82.67). The significant difference was observed in varieties, treatments and cumulative interaction of both parameters. Among varieties, the mean value of germination percentage was higher in MH-318 (84.82) than in MH-421 (83.48). The higher germination percentage may be attributed to bolder seeds which contain greater metabolites for the resumption of embryonic growth during germination and a better accumulation of food reserves like protein and carbohydrates as reported by Anitha *et al*. (2015) in fenugreek. The results are in accordance with the findings of Lal *et al*. (2015) on fenugreek and Deepika and Anitha (2016) on radish.

Seedling length (cm)

The data presented in table 1 indicates that among treatments, maximum seedling length was observed in treatment T5 (47.93) followed by treatment T6 (47.87) and the minimum was found in control T1 (40.93) in MH-421. While in variety MH-318, the maximum seedling length was observed in treatment T6 (46.93) followed by T8 (45.00) and minimum was observed in control *i.e.,* T1 (39.60). There was a significant difference in varieties, treatments and cumulative interaction of both parameters *i.e.,* V ×T. The increase might be due to the accumulation of more seed constituents that resulted in higher seedling length. Ali and Idris (2015) stated that large seed size produced the highest seedling length in fababean.

Dry weight (mg)

The overall mean value of dry weight (Table 1) of mungbean indicates the maximum dry weight was recorded in treatment T6 (18.67) followed by treatment T5 (18.00) and treatment T4 (17.00) while the minimum was recorded in control (13.50) in variety MH-421 (Table 2). Treatment T7 had the highest mean value of variety MH 318 (20.67) followed by treatment T6 (20.00) and treatment T4 (19.00) with control having the lowest (13.67). The significant difference was observed with varieties and treatments and a non-significant difference was found with the cumulative interaction of both parameters. Among varieties, the mean value of dry weight

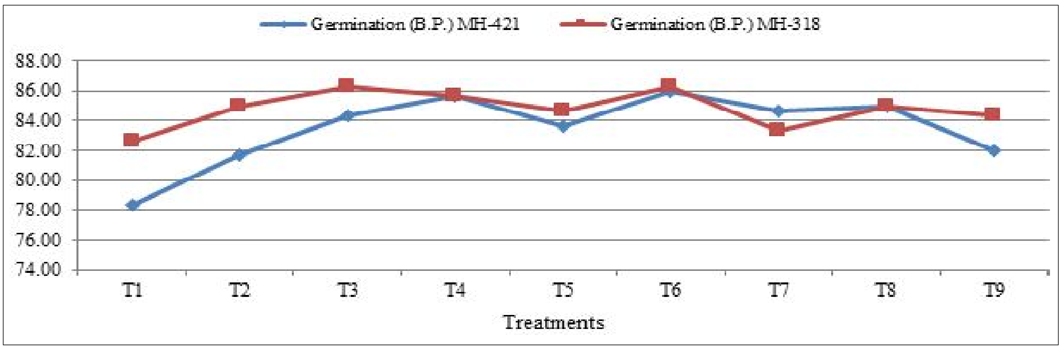

Fig 1: Effect of foliar spray on standard germination (%) of mungbean varieties.

Table 1: Effect of foliar spray on seedling length (cm) and dry wt. of seeding (mg) of mungbean varieties.

Treatments		Seedling length (cm)			Dry wt. of seeding (mg)		
		MH-421	MH-318	Mean	MH-421	MH-318	Mean
Control (untreated)	T1	40.93	39.60	40.27	13.50	13.67	13.58
Water spray	T2	41.13	43.87	42.50	15.33	14.67	15.00
Urea 1%	T3	46.80	43.13	44.97	16.33	16.67	16.50
Urea 2%	T4	46.80	40.27	43.53	17.00	19.00	18.00
NPK (18-18-18) 1%	T5	47.93	42.07	45.00	17.00	18.33	17.67
NPK (18-18-18) 2%	T6	47.87	46.93	47.40	18.67	20.00	19.33
$ZnSO_4$+ Urea	T7	45.87	43.13	44.50	18.00	20.67	19.33
SOP (0-00-52)	T8	47.60	45.00	46.30	16.10	15.33	15.72
Urea phosphate (17-44-0)	T9	46.40	44.33	45.37	16.83	16.67	16.75
Mean		45.70	43.15		16.53	17.22	
		V	T	V×T	V	T	V×T
C.D.		0.736	1.561	2.207	0.68	1.45	NS
SE(m) ±		0.255	0.542	0.766	0.24	0.50	0.71

V= Variety, T=Treatment, V × T = Interaction between variety and treatment, CD= Critical difference, SE (m) =Standard error in mean, NS = Non significant.

Table 2: Effect of foliar spray on vigour indices of mungbean varieties.

Treatments		Vigour index-I			Vigour index-II		
		MH-421	MH-318	Mean	MH-421	MH-318	Mean
Control (untreated)	T1	3206.13	3337.73	3271.93	1058.67	1153.33	1106.00
Water spray	T2	3359.60	3773.60	3566.60	1252.33	1259.00	1255.67
Urea 1%	T3	4057.60	3722.87	3890.23	1418.67	1442.67	1430.67
Urea 2%	T4	4180.53	3625.47	3903.00	1517.67	1711.33	1614.50
NPK (18-18-18) 1%	T5	4185.60	3604.87	3895.23	1483.33	1604.67	1544.00
NPK (18-18-18) 2%	T6	4294.53	4224.00	4259.27	1678.00	1800.00	1739.00
$ZnSO_4$+ Urea	T7	3883.53	3824.13	3853.83	1524.33	1830.00	1677.17
SOP (0-00-52)	T8	4093.73	3989.87	4041.80	1397.33	1359.67	1378.50
Urea phosphate (17-44-0)	T9	4037.60	3960.40	3999.00	1465.67	1488.67	1477.17
Mean		3922.10	3784.77		1421.78	1516.59	
		V	T	V×T	V	T	V×T
C.D.		97.44	206.69	292.31	51.92	110.13	NS
SE(m) ±		91.07	193.18	273.19	18.03	38.24	54.08

V= Variety, T= Treatment, V × T = Interaction between variety and treatment, CD= Critical difference, SE (m) =Standard error in mean, NS = Non significant.

was higher in MH-318 (17.22) than in MH-421 (16.53).The accumulation of higher quantities of seed constituents like carbohydrates in the seed is due to the participation of micronutrients (Zn, Fe, B) in catalytic activity and the breakdown of complex substances into simple forms (glucose, amino acids and fatty acids *etc.*). These in turn reflected on enhancing the germination, elongation of root and shoot in brinjal seedling (Yoganand, 2001) and higher seedling length there by increased seedling dry weight. Similar results were reported earlier in bitter gourd by Arvind Kumar *et al*. (2012).

Vigour index-I and II

The perusal of data in Table 2 showed that vigour index-I was found significant with varieties, treatments and their cumulative interaction at all levels for both the varieties *i.e.,* MH-421 and MH-318. The vigour index-I was observed best in MH-421 with treatment T6 (4294.53) followed by treatment T5 (4185.60) and T4 (4180.53) while the minimum was observed in control (3206.13). While in MH-318, higher vigour index-I was observed in treatment T6 (4224.00) followed by T8 (3989.87) and treatment T9 (3960.40) while the minimum was observed in control (3337.73). Among varieties, the mean value of vigour index-I was higher in MH-421 (3922.10) than MH-318 (3784.77). The maximum vigour index-II was found in treatment T6 (1678.00) followed by treatment T7 (1524.33) and T4 (1517.67) while the minimum was found in control *i.e.,* T1 (1058.67) in MH-421. The results of vigour index-II was found maximum in treatment T6 (1800.00) followed by T7 (1830.00) and T4 (1711.33) while minimum was found in control *i.e.,* T1 (1153.33) in variety MH-318. Among varieties, the overall mean value of MH-318 (1516.59) was better than MH-421 (1421.78) by 6.70 per cent. The vigour Index is used as a parameter of seed quality. Its potential can be determined in terms of seedling length, seedling dry matter and germination percentage. The superiority might be due to bolder seeds which have higher germination percentage; vigour index and seedling dry weight. Supportive evidence was shown by Kumar and Sarlach (2015).

The present investigation showed differences in enzyme activities among different micronutrient treatments. The antioxidant enzymes showed varied differences among all the treatments.

Catalase (µmol g^{-1} FW)

The perusal of the data in Table 3 showed the impact of foliar spray on catalase of mungbean. The effect was found

Table 3: Effect of foliar spray on biochemical parameters of mungbean varieties.

Treatments		MH-421	MH-318	Mean	MH-421	MH-318	Mean
			DHA (O.D.g^{-1}ml^{-1})			**Peroxidase (n moles g^{-1} FW)**	
Control (untreated)	T1	2.46	2.05	2.26	23.89	64.11	44.00
Water spray	T2	2.40	1.74	2.07	19.17	42.89	31.03
Urea 1%	T3	2.50	1.54	2.02	34.39	18.05	26.22
Urea 2%	T4	2.86	2.34	2.60	26.33	43.78	35.06
NPK (18-18-18) 1%	T5	2.14	1.23	1.69	36.50	12.55	24.53
NPK (18-18-18) 2%	T6	2.98	2.38	2.68	31.28	61.83	46.56
$ZnSO_4$+ Urea	T7	2.06	1.42	1.74	18.39	37.83	28.11
SOP (0-00-52)	T8	2.21	2.35	2.28	25.67	24.00	24.83
Urea phosphate (17-44-0)	T9	1.73	1.95	1.84	21.72	16.89	19.31
Mean		2.37	1.89		26.37	35.77	
		V	T	V×T	V	T	V×T
C.D.		0.13	0.27	0.38	4.93	10.45	14.77
SE(m) ±		0.04	0.09	0.13	1.71	3.63	5.13
			Catalase (µmol g^{-1}FW)			**SOD (x unit g^{-1} FW)**	
Water spray	T2	784.92	755.43	770.17	19.17	42.89	31.03
Urea 1%	T3	757.25	773.10	765.18	34.39	18.05	26.22
Urea 2%	T4	736.79	712.39	724.59	26.33	43.78	35.06
NPK (18-18-18) 1%	T5	507.21	776.18	641.69	36.50	12.55	24.53
NPK (18-18-18) 2%	T6	322.77	752.35	537.56	31.28	61.83	46.56
$ZnSO_4$+ Urea	T7	572.53	345.05	458.79	18.39	37.83	28.11
SOP (0-00-52)	T8	667.82	726.22	697.02	25.67	24.00	24.83
Urea phosphate (17-44-0)	T9	758.79	713.93	736.36	21.72	16.89	19.31
Mean		650.77	702.15		26.37	35.77	
		V	T	V×T	V	T	V×T
C.D.		21.10	44.76	63.30	4.93	10.45	14.77
SE(m) ±		7.33	15.54	21.98	1.71	3.63	5.13

V= Variety, T=Treatment, V × T = Interaction between variety and treatment, CD= Critical difference, SE (m) =Standard error in mean.

to be significant with varieties, treatments and their cumulative interaction at all levels for both the varieties. Catalase after treatments was observed best in MH-421 with treatment T4 (736.79) followed by treatment T9 (758.79) and treatment T3 (757.25) while the minimum effect was observed in control (748.90). The trend in MH-318 was observed in treatment T5 (776.18) followed by treatment T3 (773.10) and treatment T6 (752.35) while the minimum effect was observed in control (764.65). The treatment of T3 was at par for both the varieties. Among varieties, the mean value of catalase was higher in MH-318 (702.15) than in MH-421 (650.77).

Dehydrogenase activity test (O.D.$g^{-1}ml^{-1}$)

The overall mean values of DHA indicates that the maximum was observed in treatment T6 (2.98) followed by treatment T4 (2.86) while the minimum was found in control (2.46) in variety MH-421. The mean value of variety MH 318 was also highest in treatment T6 (2.38), followed by treatment T8 (2.35) and treatment T4 (2.34), with control (2.05) being the lowest. There was a significant difference observed with regard to varieties, treatments and cumulative interaction. Among varieties, the mean value of DHA was higher in MH-421 (2.37) than in MH-318 (1.89).

Peroxidase (n moles g^{-1} FW)

The data presented in Table 3 indicated that among treatments, maximum peroxidase activity was found in treatment T5 (36.50) followed by treatment T3 (34.39) and treatment T6 (31.28) while the minimum was found in control *i.e*., T1 (23.89) in MH-421. Whereas in variety MH-318, the maximum peroxidase activity was found in treatment T6 (61.83) followed by treatment T4 (43.78) and treatment T2 (42.89) while the minimum was found in control *i.e.,* T1(64.11).

Super oxidase-dismustase (x unit g^{-1} FW)

The data pertaining to SOD indicated that the maximum improvement was seen in treatment T6 (24.78) followed by treatment T8 (22.06) and treatment T9 (21.64) while the minimum was observed in control (12.87) in MH-421. In terms of SOD, a similar trend was observed in variety MH-318, with the mean value being highest in treatment T6 (22.70) followed by treatments T8 (21.57) and T9 (20.52) and lowest in control (14.05).

The increased activities of these enzymes helped in the removal of free radicals like H_2O_2 and O_2 available in normal or abnormal conditions and maintained the ascorbate pool, which in turn led to better growth and tolerance in the plant. Similar findings have been reported by Abd El-Ghany (2007) in wheat and Siavoshi *et al*. (2013) in rice.

CONCLUSION

The foliar spray with different nutrients significantly improved all the seed quality parameters such as standard germination (%), seedling length (cm), seedling dry weight (mg), vigour index I and II and biochemical parameters (catalase, superoxidase, peroxidase and dehydrogenase) as compared to control in both varieties (MH 318 and MH 421) of mungbean. Superior maintenance of seed quality was reported in seeds sprayed with NPK (18-18-18) at 2 per cent in both the varieties of mungbean.

Conflict of interest: None.

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