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Effect of foliar nutrition on yield and economics of mungbean [*Vigna radiata* (L.) Wilczek]

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ABSTRACT

A field experiment was carried out during *kharif* season of 2016 and 2017 at M.G.C.G.V., Chitrakoot to evaluate the effect of foliar nutrition on productivity of mungbean. Treatment consisted T_1 : Control (Water spray), T_2 : Foliar spray of Urea 2% at flower initiation, T_3 : Foliar spray of TNAU Pulse Wonder @ 5 kg/ha at flower initiation, T_4 : Foliar spray of Salicylic Acid 75 ppm at flower initiation and 7 Days after first spray, T_5 : Foliar spray of NPK (18:18:18) 2% spray at flower initiation, T_6 : Foliar spray of Urea 2% + Salicylic Acid 75 ppm at flower initiation, T_7 : Foliar spray of Boron 0.25 ppm at flower initiation and T_8 : Foliar spray of Nitrobenzene 500 ppm at flower initiation. Result showed that yield attributes viz. pods/plant and pod length was observed statistically superior under foliar spray of Salicylic Acid 75 ppm at flower initiation and 7 Days after first spray while, grains/pod and seed weight/plant was obtained numerically higher under of Nitrobenzene @ 500 ppm at flower initiation. Seed yield (545 kg/ha) and net returns (Rs 30578/ha) was recorded significantly superior under foliar spray of urea 2% + salicylic acid 75 ppm at flower initiation followed by Boron @ 0.25 ppm at flower initiation (523kg/ha; Rs 29905/ha) and urea 2% spray at flower initiation (520kg/ha; Rs 29937/ha) which gave by a margin of 124 kg (29.45%), 102 kg (24.22%) 99 kg (23.51%) higher seed yield and Rs 10093 (49.27%), Rs 9420 (45.98%) and Rs. 8752 (42.72%) greater net returns over control, respectively. Significant higher benefit: cost ratio was noted in urea 2% spray at flower initiation (2.59) followed by of urea 2% + salicylic acid 75 ppm at flower initiation (2.58).

Key words **:** Foliar nutrition, Mungbean, Yield attributes

Mungbean [*Vigna radiata* (L.) Wilczek] is an important grain legume crop in arid and semi-arid regions, cultivated for edible green pods and dry seeds and considered as a good source of protein for both humans and animals. It is a short duration crop grown during rainy and spring season. Being a leguminous in nature it has the ability to fix nitrogen from the atmosphere by the roots having nodules through microbial symbiosis. It is one of the important pulse crop cultivated in India having about 70% of the world area and 45% of production. In Madhya Pradesh mungbean crop was grown on 295 thousand hectare area which produce 126.3 thousand tonnes production with a productivity of 428 kg/ha (Anonymous, 2018-19). The low productivity of mungbean is due to biotic and abiotic stresses. Among them nutrient play a vital role in increasing the production of pulses. Soil application of nutrients often results in lower efficiency of concerned nutrient. The soil applied nutrients undergo several changes and losses which occur through leaching and volatilization. Thus foliar application of nutrients is imperative. Foliar application is credited, with advantage of quick and efficient utilization of nutrients, elimination of losses through leaching, fixation and regulating the uptake of nutrients by plant (Manonmani and Srimathi., 2009). Since foliar nutrient usually penetrate the leaf cuticle or stomata and enters the cell facilitating easy and rapid utilization of nutrients. Foliar application of N at particular stage may solve the growth, nodule senescence and low seed yield of pulses without involving root absorption at critical stage (Latha and Nadanasanady, 2003). Nutrient and growth regulators as foliar application at pre-flowering and flowering stage was seen on reduction in flower drop percentage in green gram (Ganapathy *et al.,* 2008). Foliar spray technique helps the nutrients to reach the site of food synthase directly, leading no wastage and quickly supply of food and thereby reduce the requirement of fertilizer. Foliar nutrition can be hastening growth of a crop suddenly. It is also known that active nodulation of pulse crop stop after 45 to 50 days after sowing and at the time positive effect of supplying legume plants with supplementary nitrogen was found and increasing seed yield by quickly supply of nitrogen. Patla *et al.,* (2005) and

Zeiden, (2003) reported that foliar application of urea at 50 % flowering increased the yield and seed protein in legumes, leaf senescence starts earlier before completion of maturity which break the source to sink relation, thereby reduce the yield. Nitrogen spray has been found to delay leaf senesce and improved yield. TNAU Pulse wonder increased drought tolerance and reduce flower drop in pulses. Foliar application of salicylic acid during flowering and branching increased the flowers, pods, seeds/pod and seed yield in green gram. Boron spray improved nutrient uptake from soil, translocation of sugar involved in reproduction of plants and germination of pollen grains. However, the role of NPK is well known in pulses. Keeping these points in view, the present study was undertaken to find out the appropriate foliar nutrient for higher productivity of mungbean.

MATERIALS AND METHODS

A field experiment was conducted at Agriculture Farm of the Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot District Satna (M.P.) during *kharif* season of 2016 and 2017. The farm is situated under Kymore Plateau of Northern Madhya Pradesh (25^0 102 N latitude, $80^0$322 E longitude and 190-210 meter above mean sea level). The soil of experimental field was sandy loam with pH7.79 and 7.75, low in organic carbon (0.49% and 0.24%) and available nitrogen (223.50 and 108.5 kg/ha) and available phosphorus of 54.51 and 8.60 kg/ha, medium in available potash (152.49 and 185 kg/ha) and available boron (0.12 and 0.25 mg/kg). Treatment consisted T_1 : Control (Water spray), T_2 : Foliar spray of Urea 2% at flower initiation, T_3 : Foliar spray of TNAU pulse Wonder @ 5 kg/ha at Foliar initiation, T_4 : Foliar spray of Salicylic Acid 75 ppm at Foliar initiation and 7 Days after first spray, T_5 : Foliar spray of NPK (18:18:18) 2% spray at Foliar initiation, T_6 : Foliar spray of Urea 2% + Salicylic Acid 75 ppm Foliar initiation, T_7 : Foliar spray of Boron 0.25 ppm at Foliar initiation and T_8 : Foliar spray of Nitrobenzene @ 500 ppm at Foliar initiation. Thus eight treatments were tried in a three replicated randomized black design. Mungbean (cv. PDM-139) was sown July 21, 2016 and July 19, 2017 in furrows at a row spacing of 30cm apart using seed rate 20 kg/ha.

Seed was treated with thiram @ 2.5 g/kg seed before seed inoculation for protecting fungal infection. Thereafter, it was inoculated with *Rhizobium* culture @ 20 g/kg seed followed by phosphorus solubilizing bacteria (PSB) @ 40 g/kg seed. The crop was fertilized @ 20 kg N+ 40 kg P_2O_5 + 20 kg K_2O/ha uniformly as basal dressing through DAP, Urea and Muriate of potash. The foliar spray of different nutrients were done at initiation of flowering in all treatments. In treatment T_4 salicylic acid 75 ppm was further sprayed 7 days after first spray. Six hundred litre/ha water was used for preparation of solution in foliar spray. Weeds of crop field was controlled by using Pendimethalin @ 1 kg a.i./ha as pre-emergence with one hand weeding at 20 DAS. The crop was protected from insect pest by using Dimethoate @ 2ml/litre of water (600 litre of water/ha). The crop was grown as per recommended package and practices and harvested on 28th September 2016 and 17th September 2017. The important growth parameters, yield attributes and yield were recorded at appropriate time as per standard procedure. The economics was calculated on the basis of prevailing market rates of the area. The experimental data was statistically analysed by Gomez and Gomez (1984). The treatment differences were tested by using "F" test and critical differences at 5% probability.

RESULT AND DISCUSSION

Effect of yield attributes

Yield attributes viz. pods/plant (15.80) was recorded significantly higher under salicylic acid 75 ppm at FI (T_4) and statistically at par with all the foliar applied treatment. Pod length was observed conspicuously more under salicylic acid 75 ppm at FI (T_4) and nitrobenzene 500 ppm at FI (T_8). However, grains/pod (10.01) and seed weight /plant (7.31) was noted numerically more under nitrobenzene @500 ppm at FI (T_8). While, 1000-seed weight was recorded marginally higher (33.95g) under TNAU pulse wonder @ 5kg/ha (T_3) followed by nitrobenzene @ 500 ppm at FI (T_8). The better yield attributes under foliar treatment was due to improve morphological characters of mungbean viz. plant height, leaves/plant and dry matter accumulation/plant. This might be because of role of NPK and growth hormone which improves chlorophyll content, soluble protein and nitrate reductase activity. Singh *et al.* (1980) found that foliar application of salicylic acid at branching and flower bud initiation stages increased the number of flower/ plant, pods /plant, seeds/pods and seed yield kg/ha in green gram. The findings are in agreement with result of Anuradha *et al.* (2011) and Pandey *et al.* (2013), Kumar *et al.* (2013), Ali *et al.* (2013) and Shivkumar and Nagaraj (2018).

Effect of yields

All foliar nutrition treatment produced significantly higher seed yield than control except T_3 TNAU pulse wonder @ 5kg/ha at FI (T_3). Foliar spray of urea 2% + Salicylic acid @ 75 ppm at flower initiation gave significantly superior seed yield (545 kg/ha) followed by foliar spray of boron 0.25 ppm at FI (523 kg/ha), urea 2% at FI (520 kg/ha), NPK (18:18:18) 2%

Table 1. Effect of foliar nutrition on yield attributes on mungbean (Pooled data of 2 years).

Treatments	Yield attributes				
	Pods/plant	Pod length (cm)	Grains/pod	Seed weight/plant (g)	1000-seed weight (g)
T_1 Control (water spray)	13.03	5.81	9.54	6.82	33.63
T_2 Urea 2% spray at FI	14.57	6.01	9.49	7.29	33.73
T_3 TNAU pulse Wonder 5 kg/ha at FI	14.00	5.92	9.48	7.08	33.95
T_4 Salicylic Acid 75 ppm at FI and 7 Days Ist spray	15.80	6.02	9.50	6.85	33.80
T_5 NPK (18:18:18) 2% spray at FI	14.53	5.97	9.57	7.25	33.50
T_6 Urea 2%+Salicylic Acid 75 ppm FI	13.93	5.91	9.63	7.07	33.70
T_7 Boron 0.25 ppm at FI	14.25	5.94	9.65	7.01	33.75
T_8 Nitrobenzene 500ppm at FI	13.87	5.89	10.01	7.31	33.75
SEm ±	**0.69**	**0.42**	**0.36**	**0.52**	**0.86**
CD (P=0.05)	**1.98**	**NS**	**NS**	**NS**	**NS**

Table 2. Effect of foliar spray on yield and harvest index of mungbean.

Treatments	Seed yield (kg/ha)			Stover yield (kg/ha)			Harvest index (%)		
	2016	2017	Pooled	2016	2017	Pooled	2016	2017	Pooled
T_1 Control (water spray)	425	418	421	1929	2490	2209	17.67	14.36	16.01
T_2 Urea 2% spray at flower initiation	506	535	520	3262	2864	3063	18.00	15.74	16.87
T_3 TNAU pulse Wonder 5 kg/ha at FI	492	456	474	2540	2807	2673	15.67	14.90	15.29
T_4 Salicylic Acid 75 ppm at FI and 7 Days Ist spray	513	516	514	2246	2298	2272	18.33	16.05	17.19
T_5 NPK (18:18:18) 2% spray at FI	527	511	519	2262	2493	2377	18.67	17.01	17.84
T_6 Urea 2%+Salicylic Acid 75 ppm FI	550	540	545	2619	3134	2876	17.67	14.68	16.18
T_7 Boron 0.25 ppm at FI	511	535	523	2500	2896	2698	18.00	17.05	17.53
T_8 Nitrobenzene 500 ppm at FI	500	483	491	2104	2738	2421	18.67	15.06	16.87
SEm ±	**18.77**	**26.13**	**21.88**	**147.00**	**153.56**	**171.31**	**0.46**	**0.51**	**0.54**
CD (P=0.05)	**56.94**	**79.26**	**62.71**	**445.87**	**465.77**	**490.89**	**1.41**	**1.54**	**1.55**

Table 3. Effect of foliar spray on economics of mungbean.

Treatments	Economics											
	Cost of cultivation (Rs/ha)			Net returns (Rs/ha)			Gross returns (Rs/ha)			B:C ratio		
	2016	2017	Mean	2016	2017	Pooled	2016	2017	Pooled	2016	2017	Pooled
T_1 Control (water spray)	18927	18926	18926	27376	13593	20485	46334	30080	38207	2.45	1.84	2.15
T_2 Urea 2% spray at flower initiation	19011	19010	19010	35684	22791	29237	54695	37849	46272	2.87	2.30	2.59
T_3 TNAU pulse Wonder 5 kg/ha at FI	19944	19943	19943	34283	16430	25356	54227	33759	43993	2.71	1.94	2.33
T_4 Salicylic Acid 75 ppm at F.I. and 7 Days Ist spray	20198	20197	20197	35568	19686	27627	55766	35364	45565	2.75	2.18	2.46
T_5 NPK (18:18:18) 2% spray at FI	21062	21061	21061	36133	17208	26670	57195	36440	46817	2.71	1.93	2.32
T_6 Urea 2%+Salicylic Acid 75 ppm FI	20282	20281	20281	39996	21161	30578	60278	38749	49513	2.97	2.20	2.58
T_7 Boron 0.25 ppm at FI	18928	18927	18927	40207	19603	29905	56135	34910	45522	2.96	2.20	2.58
T_8 Nitrobenzene 500 ppm at FI	18973	18972	18972	35253	18123	26688	54226	34476	44351	2.85	2.10	2.48
SEm ±	-	-	-	1956.6	1697.5	1820.8	1568.5	1463.3	1517.5	0.10	0.10	0.10
CD (P=0.05)	-	-	-	5934.9	5148.9	5217.4	4757.5	4438.6	4348.3	0.30	0.29	0.28

at FI (519 kg/ha) and salicylic acid @ 75ppm (514 kg/ha) which were statistically at par. The stover yield was recorded significantly higher under foliar spray of urea 2% at flower initiation (3063 kg/ha) followed by urea 2% + Salicylic acid @ 75 ppm at FI (2876 kg/ha), boron 0.25 ppm at FI (2698 kg/ha) and TNAU pulse wonder @ 5kg/ha at FI (2673 kg/ha) which exhibited statistically at par. The highest harvest index was calculated (17.84%) in T_5 foliar spray of NPK (18:18:18) and T_7: boron 0.25 ppm at FI (17.53%) and T_4 Salicylic acid @ 75 ppm at FI (17.19%). The higher yield could be ascribed to better growth and yield attributes of green gram. In these treatments, additional nutrient was supplied through foliar spraying in addition to basal application of nutrients. Urea and salicylic acid provide nitrogen and salicylic acid which works as growth hormone regulate physiological process in transport membrane permeability and photosynthesis via increasing assimilation rate that revealed increasing in chlorophyll content and hill reaction activity in the leaf. Foliar application of salicylic acid during branching and flower bud initiation stage increased seed yield in greengram (Singh *et al.*, 1980). These results are agreement to those of Jeya Kumar (2008), Ali and Mahmoud (2013) and Sujatha (2001). Foliar spray of NPK increased chlorophyll content and formation of more photosynthesis. Verma *et al.* (2011) and Kothale *et al.* (2003) reported higher straw yield with foliar spray of nutrients.

Effect on Economics

Gross and net returns were significantly improved due to foliar nutrition. Foliar spray of urea 2% + salicylic acid 75 ppm at flower initiation achieved the maximum gross returns (Rs 49513/ha) and net returns (Rs 30578/ha) closely followed by gross returns under foliar spray of urea 2% at flower initiation (Rs 46272/ha) and net returns (Rs 29905/ ha) under foliar spray of boron 0.25 ppm at flower initiation. All foliar nutrition treatment showed significantly at par net returns. Gross return was in the trend of seed and stover yield of mung bean. This net returns was due to trend of gross returns and cost of cultivation incurred in mungbean cultivation. The result of gross returns and net returns was supported by Shukla *et al.* (2013), Ali *et al.* (2013), Kuttimani and Velayutham (2011), Kumar *et al.* (2013). Singh *et al.* (2013) and Devi *et al.* (2015) reported that foliar application of thiourea @ 500 ppm in green gram gave highest net returns. The variation in cultivation cost was due to variable input cum operation involved in different treatment. The maximum benefit: Cost ratio was obtained under T_6 urea 2% at FI (2.59) closely followed by T_6: urea 2% + salicylic acid 75 ppm (2.58) and T_7: Boron spray 0.25ppm (2.58). This could be ascribed due to high value of gross returns as compared to cost of cultivation. Baldev and Punia (2018) and Singh *et al.* (2015) supported the result.

Thus it can be concluded that application of urea 2% + salicylic acid 75ppm at flower initiation (T_6) was found the best treatment for higher grain yield and net returns for rainfed conditions of Kymore Plateau of Madhya Pradesh.

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