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Effect of folior application of macronutrients (N, P and K) on nutrient uptake in different growth stages of green gram

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Abstract
The field experiment was carried out on "Effect of folior application of macronutrients (N, P and K) on growth and yield of green gram." during kharif season of the year 2017-18 at the Research farm of College of Agriculture, Latur. The experiment was laid in randomized block design with three replications and variety BM 2003-2 as a test crop along with eight treatments viz., T1 - Control, T2 - RDF + Water Spray, T3 - RDF + 19:19:19 @ 0.5 % at vegetative stage, T4 - RDF + 00:52:34 @ 1.0 % at flowering stage, T5 - RDF + 13:00:45 @ 1.0 % at grain filling stage, T6 - T3 + T4, T7 - T4 + T5 and T8- T3 + T4 + T5.
The results of field study indicated that, the growth, yield uptake and quality of green gram were significantly influenced by foliar application of macronutrients (N, P and K). The growth parameters viz., plant height, number of branches, number of leaves plant-1, leaf area plant-1, number of pod plant-1 and dry matter of green gram were significantly improved due to treatment T8 (RDF + 19:19:19 @ 0.5 % at vegetative stage, RDF + 00:52:34 @ 1.0 % at flowering stage and RDF + 13:00:45 @ 1.0 % at grain filling stage). Whereas, yield contributing characters viz., seed yield, straw yield and biological yield as well as quality parameters such as protein content, protein yield and test weight of seed in green gram were also increased

Keywords: application, nutrient, growth, protein, biological

Introduction
Green gram (Vigna radiata L Wilczek) belongs to the family leguminoceae and sub family papilionaceae, is being grown as one of the principal crop since ages in our state as well as in the country. The annual world production area of green gram is about 5.5 million hectare and India is the primary green gram producer and contributes about 75% of the world's production. Green gram output accounts for about 10-12% of total pulse production in the country (Anonymous, 2016) [2]. It is highly nutritious pulse crop having nearly 24 to 25% protein in seed.
Foliar application is more beneficial than soil application because less quantity of fertilizer is required for the foliar application as compare to soil application. The prices of fertilizers are increasing day by day therefore, it is necessary to reduce the cost of fertilizers by using foliar application of nutrients to increase yield of legume crop. In Maharashtra there was regularly dry spell of 15 to 35 day during kharif season, which severely affect the growth and yield of green gram. It is evident from the literature that the foliar nutrition with nutrients helps in increasing drought resistant in plant and reduces the loss of water through evapotranspiration.
Foliar feeding is a technique of a feeding nutrient to plant by applying liquid fertilizer (either in solution or suspension) directly to the crop canopy. It used wisely, it can more efficient and economical environmental friendly target oriented when used supplement soil fertilization now days, foliar feeding is widely adopted strategy in modern crop management where it is used to ensure higher or optimum crop performance by improve crop growth at certaingrowth stage, correcting the nutrient deficiency in crop and enhancing crop tolerance to adverse condition for crop growth. Foliar application overcome soil fertilization limitations soil unsuitable for fertilizer precipitation, antagonism between certain nutrient, heterogenic soil unsuitable for lower dosages and fixation, absorption reaction like in the case of potassium, Therefore attempts were made to know the effect of foliar application of macronutrients on growth and yield of green gram

Material and methods
The experiment was conducted at Research Farm, College of Agriculture, Latur during kharif season 2017-2018. The topography of experimental field was uniform and leveled. The field experiment was carried out on "Effect of folior application of macronutrients (N, P and K) on growth and yield of green gram." during *kharif* season of the year 2017-18 at the Research farm of College of Agriculture, Latur. The experiment was laid in randomized block design with three replications and variety BM 2003-2 as a test crop along with eight treatments viz., T_1 - Control, T_2 - RDF + Water Spray, T_3 - RDF + 19:19:19 @ 0.5 % at vegetative stage, T_4 - RDF + 00:52:34 @ 1.0 % at flowering stage, T_5 - RDF + 13:00:45 @ 1.0 % at grain filling stage, T_6 - T_3 + T_4, T_7 - T_4 + T_5 and T_8- T_3 + T_4 + T_5.

Results and discussion
The results regarding uptake of nitrogen estimated at different growth stages are presented in the table 1. The N uptake by green gram crop was significantly influenced by different foliar application treatments at all the growth stages. Significantly higher N uptake was observed with the treatment T_8 at vegetative (53.15 kg ha^{-1}), flowering (52.79 kg ha^{-1}), pod development 49.91kg ha^{-1}) and at harvest stage (48.48 kg ha^{-1}) over the treatments.

The treatment T_1 (Control) recorded significantly lower N uptake than, the rest treatment. The treatment at vegetative (33.89 kg ha^{-1}), flowering (33.64 kg ha^{-1}), pod development (32.87 kg ha^{-1}) and at harvest stage (31.22 kg ha^{-1}). The treatments T_6 and T_7 were at par with the each other at all the growth stages of green gram. Similar findings were reported by Shashikumar et al., (2013), their investigation showed that significantly higher nitrogen uptake (88.32 kg ha^{-1}) was recorded in treatment, RDF + foliar spray of 40 ppm NAA + 0.5 per cent chelated micronutrient + 2 per cent DAP over.

Table1: Effect of foliar application of micronutrients on uptake (kg ha^{-1}) of N by green gram

Treatments	N uptake (kg ha^{-1})			
	Vegetative stage	Flowering stage	Pod development stage	At Harvest
T_1: Control	33.89	33.64	32.87	31.32
T_2: RDF + Water spray	37.81	37.52	36.67	35.53
T_3:RDF+19:19:19@0.5% at vegetative stage	43.60	42.96	41.67	40.71
T_4:RDF+00:52:34@1.0% at flowering stage	44.90	43.62	40.03	41.40
T_5:RDF+13:00:45@1.0% at grain filling stage	45.61	44.64	42.71	42.39
T_6: T_3 + T_4	47.75	47.42	45.13	44.15
T_7: T_4 + T_5	49.25	48.91	46.52	45.15
T_8: T_3 + T_4 + T_5	53.15	52.79	49.91	48.84
S.Em±	0.69	0.46	0.50	0.86
CD at 5%	2.93	1.42	1.53	2.62

Rest of the treatments. Similar findings were also reported by Reddy (2015) studied on effect of uptake and quality of soybean in revealed that uptake of N (164.82 kg ha^{-1}), P (11.26 kg ha^{-1}) and K (66.48 kg ha^{-1}) followed by control.

The P uptake by green gram crop was increased with advanced stage of crop and it was significantly influenced by different macronutrients (NPK) treatments at all the growth stages. The data was presented in table 2. Significantly higher P uptake was observed with treatment T8 at vegetative (16.87 kg ha-1), flowering (15.80 kg ha-1), pod development (13.28 kg ha-1) and at harvest (12.21 kg ha-1). The treatment T1 (Control) was significantly inferior than, the rest treatment. In the treatment T1 (Control) minimum uptake at vegetative (8.73 kg ha-1), flowering (8.47 kg ha-1), pod development (7.19 kg ha-1) and at harvest stages (5.90 kg ha-1). The results also similar with those earlier reported by Yadav and Choudhary (2012) revealed that total phosphorus uptake in cowpea increased significantly with 2 per cent DAP spray as compared to water sprayed control and 2 per cent KCl. Similar results were also be reported by Mudalagiriyappa et al., (2016) [7].

Table 2: Effect of foliar application of macronutrients on uptake (kg ha^{-1}) of P by green gram

Treatments	P uptake (kg ha^{-1})			
	Vegetative stage	Flowering stage	Pod development stage	At Harvest
T_1: Control	8.73	8.47	7.19	5.90
T_2: RDF + Water spray	10.23	9.95	8.24	7.10
T_3:RDF+19:19:19@0.5% at vegetative stage	12.82	11.86	9.93	8.65
T_4:RDF+00:52:34@1.0% at flowering stage	13.37	12.42	9.87	8.91
T_5:RDF+13:00:45@1.0% at grain filling stage	13.81	13.16	10.27	9.31
T_6: T_3 + T_4	14.39	14.06	10.79	10.46
T_7: T_4 + T_5	14.70	14.36	10.94	10.26
T_8: T_3 + T_4 + T_5	16.87	15.80	13.28	12.21
S. Em±	0.67	0.39	0.16	0.46
CD at 5%	2.04	1.18	1.87	1.40

The K uptake was progressively increased in green gram crop was significantly influenced by different foliar application of macronutrients (NPK) at all the growth stages is presented in table 3. Significantly higher K uptake was observed with treatment T_8 at vegetative (54.22 kg ha^{-1}), flowering (50.27 kg ha^{-1}), pod development (48.48 kg ha^{-1}) and at harvest stages (43.45 kg ha^{-1}) of green gram. The treatment T_1 (Control) recorded minimum uptake at vegetative (35.43 kg ha^{-1}), flowering (32.61 kg ha^{-1}), pod development (29.27 kg ha^{-1}) and at harvest stages (29.27 kg ha^{-1}). This increase in concentration and uptake of K in green gram crop might be due to foliar application of K resulted into greater availability of K through leaves. Similar findings were recorded by Shashikumar *et al.*, (2013). They reported

Table 3: Effect of foliar application of macronutrients on uptake (kg ha^{-1}) of K by green gram

Treatments		K uptake (kg ha^{-1})		
	Vegetative stage	Flowering stage	Pod development stage	At Harvest
T_1: Control	35.43	32.61	29.27	29.27
T_2: RDF + Water spray	40.93	37.81	34.68	32.97
T_3:RDF+19:19:19@0.5% at vegetative stage	47.12	43.92	40.39	38.15
T_4:RDF+00:52:34@1.0% at flowering stage	47.45	43.62	40.76	38.21
T_5:RDF+13:00:45@1.0% at grain filling stage	47.53	43.36	41.43	38.22
T_6: T_3 + T_4	49.06	45.46	43.17	39.25
T_7: T_4 + T_5	50.96	46.86	45.15	40.70
T_8: T_3 + T_4 + T_5	54.22	50.27	48.48	43.45
S. Em±	0.93	0.94	0.60	0.85
CD at 5%	2.82	2.85	1.82	2.60

The results regarding concentration of NPK presented in table 4 in grain was significantly influenced due to different treatments. The concentration of N, P and K in grain was significantly higher in the treatment T_8 N (3.54 %), P (0.48%) and K (2.33%) in green gram followed by the treatments T_6 and T_7. Lower concentration of NPK in grain concentration was recorded by treatment T_1 (3.33 %), (0.38%) and (2.19%) which was significantly inferior with rest of the treatments. However the N, P and K concentrations were higher in grain. This trend may be due to high mobility of the nitrogen from vegetative tissues to reproductive organs after flowering stage.

It was evident from the result that the uptakes of N, P and K by grain were significantly influenced due to different treatments. The significantly higher uptake of N, P and K by grain were observed due to treatment T_8 (127.13 kg ha^{-1}), (17.23 kg ha^{-1}), and (83.67 kg ha^{-1}), over rest of the treatments and followed by treatments T_7. Whereas, the treatment T_1 (Control) recorded significantly lowest uptake of N, P and K (85.15 kg ha^{-1}),(9.75 kg ha^{-1}) and (56.23 kg ha^{-1}) rest of the treatment. This increasing N, P and K uptake might be due to increased availability of nitrogen to the crop and higher biomass production with increased photosynthesis.

Similar results were also be reported by Mudalagiriyappa et al., (2016) [7] and also similar results found in Muhammad et al., (2011) studied the effect of foliar and soil application of N, P and K on yield component of lentil and concluded that, the plant treated with N, P and K through both soil and foliage. Optimal concentration of N, P and K for various yield parameters was found to be 0.17 per cent N, 0.21 per cent P and 0.33 per cent K for foliage and 0.35 per cent N, 0.32 per cent P and 0.50 per cent K for soil application at pH 7.0. Multiple application of both soil and foliar application of N, P and K gave better result in yield and growth compared to single application of NPK

Table 4: Effect of foliar application of macronutrients on N, P and K concentration (%) and uptake in grain of green gram

Treatments	Grain Concentration (%) and uptake kg ha $^{-1}$					
	N Conc.	N uptake kg /ha	P Conc.	P uptake kg/ ha	K Conc.	K uptake kg/ ha
T_1: Control	3.33	85.15	0.38	9.75	2.19	56.23
T_2: RDF + Water spray	3.36	95.52	0.40	11.37	2.21	62.83
T_3:RDF+19:19:19@0.5% at vegetative stage	3.40	109	0.41	13.14	2.25	72.13
T_4:RDF+00:52:34@1.0% at flowering stage	3.42	108.91	0.42	13.37	2.24	71.33
T_5:RDF+13:00:45@1.0% at grain filling stage	3.46	111.13	0.42	13.49	2.24	71.94
T_6: T_3 + T_4	3.49	114.15	0.45	14.71	2.27	74.25
T_7: T_4 + T_5	3.47	118.69	0.43	14.70	2.26	77.30
T_8: T_3 + T_4 + T_5	3.54	127.13	0.48	17.23	2.33	83.67
S.Em±	0.04	3.76	0.01	0.51	0.01	0.97
CD at 5%	0.12	11.41	0.03	1.55	0.05	2.96

Conclusion

It can be concluded from the results that the green gram crop recorded positive response to foliar application of 0.5 per cent 19:19:19, 1 per cent 00:52:34 and 13:00:45 each at vegetative, flowering and grain filling stage, respectively along with RDF. The increased of plant height, number of leaves, number of branches, number of pod plant^{-1}, were resulted into significantly higher grain and straw yield with improved quality of seed. Also, the uptake of nutrient by crop and grain at different growth stages were maximum with application of RDF + 19:19:19 @ 0.5% at vegetative stage, RDF + 00:52:34 @ 1.0% at flowering stage and RDF + 13:00:45 @1.0% at grain filling stage. Soil properties studied in post-harvest soil were not affected due to various treatment except available k in soil. However the organic carbon content in soil was significantly increased due to treatment T_8 RDF + 19:19:19 @ 0.5% at vegetative stage, RDF + 00:52:34 @ 1.0% at flowering stage and RDF + 13:00:45 @1.0% at grain filling stage over rest of treatments.

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