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RESEARCH ARTICLE

Effect of Foliar Application of Nutrients and Growth Regulator on Growth and Yield of Green gram (*Vigna radiate* L.)

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ABSTRACT

A field experiment was conducted at the College of Agricultural Technology, Kullapuram - Theni during 2015-2016 on "Effect of foliar application of nutrients and growth regulator on growth and yield of green gram (*Vigna radiate* L.)". A randomized block design with eight treatments replicated thrice. Foliar spray treatment with the aqueous solution of nutrients was done at 30 and 45 DAS. Significant increases were recorded in plant height, dry matter accumulation, number of pod plant^{-1}, number of seed plant^{-1} and seed yield with foliar application of nutrients. Maximum grain yield was recorded under the foliar spray of DAP @ 2% + TNAU Pulse Wonder@ 5kg ha^{-1} (1%) + NAA 40 ppm at flowering and followed by DAP @ 2% + NAA 40 ppm is the viable nutrient management package to the green gram for getting higher income through higher productivity.

Keywords: *DAP, TNAU Pulse Wonder, NAA*

INTRODUCTION

Green gram *Vigna radiata* (L.) is a protein rich staple food. It contains about 25 % protein, which is almost three times that of cereals. It is consumed in the form of split pulse as well as whole pulse, and is an essential supplement of cereal based diet. Green gram improves soil physical properties and fixes atmospheric nitrogen. Green gram crop normally produces a large number of flowers but only a few retain and develop into pods. The crop suffers from excessive vegetative growth, poor harvest index and low yield mainly due to poor pod setting in spite of the fact that the flowering is profuse. Flower as well as pod shedding is common feature of green gram which is reflected in sink realization. If these potential yield barriers could be alleviated by any means, yield enhancement and improvement in quality of green gram could be achieved (Grewal, 1985). Though, green gram is an important pulse crop of India, its average yield is low, far from satisfactory or potential level. It is advisable to grow the crop during spring or summer in medium or up land situation which are mostly kept fallow during this period. Therefore, there is a scope for augmentation of its yield through agronomic manipulation.

MATERIAL AND METHODS

The field experiment was conducted during *Rabi* 2015-2016 at College of Agricultural Technology, Kullapuram, Theni situated in the Southern agro climatic zone of Tamil Nadu at 10°5' North latitude and 77°5' East longitude at an altitude of 40 m above mean sea level. The soil of the experimental field was sandy clay loam in texture with the available nitrogen 234.26 kg ha^{-1}, phosphorus 16.76 kg ha^{-1}, potassium 294.24 kg ha^{-1} and organic carbon content 0.30%. The experiment was laid out in randomized block design and replicated thrice. Experiment consisting eight treatments with different nutrients and growth regulator *viz*., T_1 - Recommended dose of fertilizer (RDF) alone, T_2 - RDF + 2 % DAP, T_3 - RDF + TNAU Pulse Wonder @ kg ha^{-1} (1%) , T_4 - RDF + NAA 40 ppm, T_5 - RDF + 2 % DAP + TNAU Pulse Wonder@ 5 kg ha^{-1} (1%) , T_6 - RDF + DAP @ 2% + NAA 40 ppm T_7 - RDF + TNAU Pulse Wonder @ 5 kg ha^{-1} (1%) + NAA 40 ppm and T_8 - RDF + 2 % DAP + TNAU Pulse Wonder @ 5 kg ha^{-1} (1%) + NAA 40 ppm. Good viable Green gram (Vamban 2) seeds having germination of 93 per cent were use at the rate of 20 kg ha^{-1}. The seeds were treated with *Rhizobium* culture half an hour before sowing. The treated seeds were sown at 30 cm between rows and 10 cm between seed to seed to maintain optimum plant population. The recommended fertilizer dose of 25 N, 50 P_2O_5, 25 K_2O kg ha^{-1} were applied as basal through urea, single super phosphate and muriate of potash in lines and incorporated at the time of sowing. Foliar application was done at flowering and pod filling stages of crop growth using high volume sprayer with a spray volume of 500 litre ha^{-1}. Recommended crop management practices

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including plant protection remained common to all the treatments. The data collected for green gram were statistically analyzed following the procedure given by Gomez and Gomez (1984). Whenever significant difference existed, critical difference was constructed at five per cent probability level. Such of those treatments where the difference are not significant were denoted as NS.

RESULTS AND DISCUSSION

Growth and physiological parameters

The significant increase in growth characters of green gram might be due to foliar spray of nutrient and growth regulator combination which play a major role in growth development and metabolism of green gram. The combination of DAP, NAA combined with macro and micronutrient (TNAU Pulse Wonder) might have favored better translocation of assimilates to sink resulted in improvement in growth and yield parameters.

There were significant differences observed among all the treatments when foliar nutrition was given. The plant height was increased as the life cycle of the crop proceeds due to its indeterminate nature of growth habit. The foliar application of 2 % DAP + TNAU Pulse Wonder @ 5 kg ha^{-1} (1%) + NAA 40 ppm (T_8) 58 cm on par with DAP @ 2% + NAA 40 ppm (T_5) 57 cm and 2 % DAP + TNAU Pulse Wonder @ 5 ha^{-1} (1%) (T_6) 55 cm recorded highest plant height, respectively at harvest (Table 1). This is due to the positive influence of foliar spray of nutrients on cell division and cell elongation, which facilitates better crop growth and development resulting in higher growth characters. These results are in line with Santosh Kumar Meena (2004).

Table 1. Effect of foliar application of nutrients and growth regulator on growth and physiological character of green gram (*Vigna radiate* L.)

Treatment	Plant height (cm)	Leaf area index (LAI)	Dry matter accumulation (g m^{-2})	Crop growth rate (kg ha^{-1} day^{-1})
T_1 - RDF (No Spray)	44	2.17	232.61	30.00
T_2 - RDF + DAP @ 2%	51	3.88	351.9	37.20
T_3 - RDF + TNAU Pulse Wonder @5kg/ha (1%)	50	3.73	337.75	34.70
T_4 - RDF + NAA 40 ppm	48	3.26	300.44	32.80
T_5 - RDF + 2 % DAP + TNAU Pulse Wonder @ 5kg/ha (1%)	**55**	4.02	339.95	40.50
T_6 - RDF + DAP @ 2% + NAA 40 ppm	**57**	4.26	345.18	41.50
T_7 - RDF + TNAU PulseWonder@5kg ha^{-1} (1%) + NAA 40 ppm	53	3.94	336.53	37.70
T_8 - RDF + DAP @ 2% +TNAU Pulse Wonder @5kg/ha (1%) +NAA 40 ppm	**58**	4.39	361.79	42.30
SEd	1.72	0.19	5.14	1.6
C.D. at 5%	5.5	0.58	15.56	2.37

* Recommended dose of fertilizer (RDF): 25 kg N, 50 kg P_2O_5 & 25 kg K_2O ha^{-1}

The maximum Leaf area at peak flowering contributes to better yielding ability in grain legumes, which is a pre-requisite to maximize the photosynthetic activity. 2 % DAP + TNAU Pulse Wonder @ 5 kg ha^{-1} (1%) + NAA 40 ppm (T_8) on par with DAP @ 2% + NAA 40 ppm (T_5) sprayed plants maintained more leaf area (Table 1) at different stages of crop growth and it was highest (4.39 and 4.26) at 60 DAS. As crop reaches towards maturity leaf area declines due to the onset of senescence phenomenon. These results are quite similar in greengram due to foliar application of combination of macro, micro nutrients and PGR.

The first prerequisite for higher yields is an increase in the dry matter accumulation (DMA) per unit area. Dry matter accumulation is an important index reflecting the growth and metabolic efficiency of the plant which ultimately influence the yield of crop. The amount of total dry matter produced is an indication of the overall efficiency of utilization of resources and better light interception. Due to presence of various nutrients and plant growth regulator in 2 % DAP + TNAU Pulse Wonder @ 5 kg ha^{-1} (1%) + NAA 40 ppm might have governed the various physiological characters that ultimately increased the dry matter production at various stages of crop growth by increasing the various growth indices and it was more at harvest (361.79 g m^2) due to more dry accumulation dry matter in plants (Table 1). It may be due to foliar application of NAA promoting the apical dominance, cell elongation and shoot development, foliar application of macro and micronutrient enhances the synthesis of carbohydrates and protein. In addition foliar application of DAP enhanced better photosynthetic activity in green gram.

The foliar nutrition has significant influences on growth indices like CGR at all growth stages (Table 1). Crop production is determined by CGR as a function of light interception by the leaf area of a crop and

is influenced by leaf area index, photosynthetic rate and leaf angle. Interaction of phytohormones and nutrients on growth and development of crop plants cause positive responses on plant growth rate. Similarly, in the present study the higher CGR (42.3 kg ha^{-1} day^{-1}) was obtained with foliar application of combination of nutrients and PGR (T_8) and in green gram similar results were obtained due to foliar application of mixture of nutrients and PGR. Sritharan *et al.* (2015) in black gram also reported the same due to foliar application of urea followed by combination of nutrients and PGR.

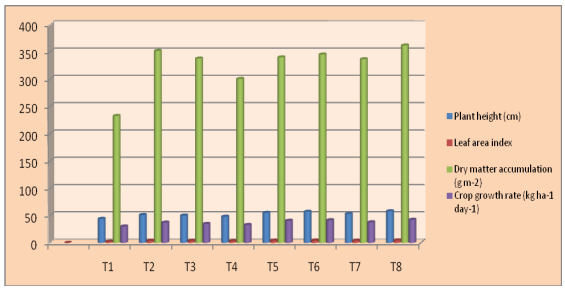
Table 2. Effect of foliar application of nutrients and growth regulator on yield and yield parameters of green gram (*Vigna radiate* L.)

Treatment	No. of pods $plant^{-1}$	Pod length (cm)	Seed yield (kg ha^{-1})
T_1 - RDF (No Spray)	17.00	3.70	654
T_2 - RDF + DAP @ 2%	29.90	4.80	986
T_3 - RDF + TNAU Pulse Wonder @ 5 kg/ha (1%)	28.80	4.80	982
T_4 - RDF + NAA 40 ppm	25.60	4.00	976
T_5 - RDF + 2 % DAP + TNAU Pulse Wonder@5kg/ha(1%)	29.90	5.00	1002
T_6 - RDF + DAP @ 2% + NAA 40 ppm	33.00	5.20	1018
T_7 - RDF + TNAU Pulse Wonder @ 5 kg ha^{-1} (1%) + NAA 40 ppm	32.30	5.10	1013
T_8 - RDF + DAP @ 2% +TNAU Pulse Wonder @5kg/ha(1%) +NAA 40 ppm	38.00	6.10	1101
SEd	0.19	1.6	27
C.D. at 5%	0.58	2.37	80

* Recommended dose of fertilizer (RDF): 25 kg N, 50 kg P_2O_5 & 25 kg K_2O ha^{-1}

Yield attributes

Days taken to attain 50% flowering were significantly delayed with increasing levels of foliar nutrients. The possible reason might be that supply of nitrogen and other nutrients are associated with protein synthesis consequently material needed for the formation of fruiting body remains scarce.



Graph 1. Effect of foliar application of nutrients and growth regulator on growth and physiological character of green gram (*Vigna radiate* L.)

To fulfil the gap, metabolism remains engaged in cell division, elongation and multiplication for vegetative growth for a longer period and thus there was a delay in the flowering. Foliar spray of 2 % DAP + TNAU Pulse Wonder @ 5 kg ha^{-1} (1%) + NAA 40 ppm (T8) on par with DAP @ 2% + NAA 40 ppm (T5) recorded the highest values for yield attributing characters *viz.,* number of pods $plant^{-1}$, number of seeds pod^{-1} and pod length than other foliar spray treatments (Table 2). The increase in yield attributes might be due to supplementation of nutrients at the critical stage without physiological stress. Foliar application of nutrients enhanced the number of floral buds, prevented the floral shedding by maintaining optimum bio-physiological conditions in plants. Adequate and continuous nutrient availability through soil and foliar nutrition promotes the supply of assimilates to sink or yield container, thus enlarging the size of the yield structure.

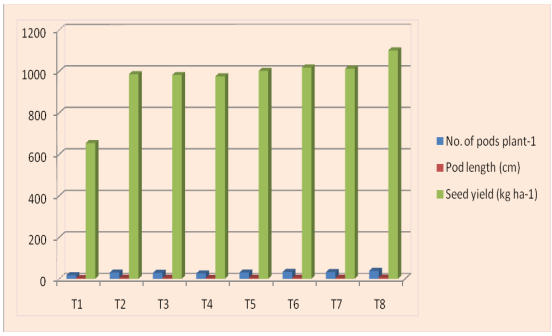
Number of pods per plant

In pulse crops No. of pods $plant^{-1}$ is the most important determinant of grain or seed yield. The number of pods/ plant ranged from 17 to 38. In treatment T_8 recorded maximum no. of pods $plant^{-1}$ (38) and it was followed by DAP @ 2% + NAA 40 ppm (T_5) this may be due to better utilization of resources in the plots receiving plant nutrients (Table 2). Kalpana and Krishnarajan (2003) also reported higher number of pods $plant^{-1}$, number of filled seeds pod^{-1}, seed filling percentage and test weight in soybean as a consequence of foliar application of macro and micronutrients along with growth regulators. This result is in conformity with the findings reported by Dixit and Elamathi (2007).

Seed yield (kg ha^{-1})

The foliar application of 2 % DAP + TNAU Pulse Wonder @ 5kg ha^{-1} (1%) + NAA 40 ppm (T_8) produced significantly increased grain yield 1101 kg ha^{-1} (Table 2). The impact of the foliar nutrients to meet the nutrient demand of the crop at the critical stage on-site, where they are needed without stress, would have resulted in better growth and development of the crop and ultimately the yield attributing

characters and yield on one hand. The balanced growth habit, which induced more flower and fruiting body production with timely supply of nutrients through foliar spray might have reduced shedding of flowers, which led to a positive source-sink gradient of photosynthates translocation due to growth regulator on the other hand. These favourable effects might have attributed for higher yield of green gram under the foliar spray of nutrients and growth regulators. This finding is in line with the results of Manivannan et al. (2002).



Graph 2. Effect of foliar application of nutrients and growth regulator on yield and yield parameters of green gram (*Vigna radiate* L.)

The foliar spraying of this might have exploited favorably for indeterminate crop for prolonged and continuous translocation of photosynthate. Apart from this, delayed senescence may also be attributed for the increase in yield. The production of higher seed yield due to growth regulators may be attributed to the fact that plants treated with growth regulators remained physiologically more active to build up sufficient food reserves for developing flowers and seeds. Similar kind of results on the foliar application of super phosphate and diammonium phosphate was found beneficial than soil application (Senthilkumar *et.al.,* 2008).

Crop performance was not good in the control treatment thus, the yields per hectare was significantly lower than that obtained in other treatments. Spraying of nutrients is effective, more efficient, and requires less amount of fertilizer in comparison with surface application and thus it is certainly beneficial from practical point of view.

CONCLUSION

The present study indicated that foliar application of 2 % DAP + TNAU Pulse Wonder @ 5kg ha^{-1} (1%) + NAA 40 ppm (T_8) on par with DAP @ 2% + NAA 40 ppm (T_5) resulted in higher grain yield. The growth parameters and yield attributes were also found to be higher when 2% DAP is given as spray at flowering and pod filling stages. This may be due to balanced growth habit, which induced more flower and fruiting body production with timely supply of nutrients through foliar spray might have reduced shedding of flowers and fruits, which led to a positive source-sink gradient of photosynthates translocation due to growth regulator. Hence, foliar application of 2 % DAP + TNAU Pulse Wonder @ 5 kg ha^{-1} (1%) + NAA 40 ppm or DAP @ 2% + NAA 40 ppm will be viable and feasible option in order to get higher yield in green gram crop.

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