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Effect of source manipulation, plant growth regulators and chemical on biochemical parameters in green gram (*Vigna radiata* L. Wilckzek) cv. GAM-5

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Abstract
The influence of source manipulation (nipping, 25% defoliation and 50% defoliation), plant growth regulators (GA_3 and NAA at 25 and 50mg/l respectively) and chemical (Thiourea 500 and 1000mg/l) on the biochemical parameters like protein content and total nitrogen, were studied using factorial randomized block design in two respective years, *i.e.*, 2016 and 2017 at 75 DAS/harvest. The biochemical parameters like protein content and total nitrogen increased at the harvesting stage of green gram under the nipping treatment and GA_3 50 mg/l at 30 DAS of the growth phase of the crop. The treatment of nipping M_2 was noted significantly higher value for protein *i.e.*, 26.63 % and for total nitrogen *i.e.*, 4.26 %. While, the treatment S_3 GA_3 50 mg/l was noted significantly higher value for protein i.e., 26.98 % and for total nitrogen i.e., 4.32 % contributing to the higher seed yield under M_2 nipping treatment *i.e.*, (1719.7 kg/ha) and S_2 treatment *i.e.*, GA_3 25 mg/l (1714.1 kg/ha). Thus, GAM-5 had a better source-sink partitioning efficiency.

Keywords: nipping, biochemical parameters, plant growth regulators, green gram

Introduction
The mungbean (*Vigna radiata* L. Wilczek) is a member of the legume family (Fabaceae) with the chromosome number 2n= 22. This family is a wide spread family as it occupies the third largest family of flowering plants, with approximately 650 genera and nearly 20,000 species (Doyle, 1994). Mungbean is a short duration legume crop cultivated primarily for their dry seeds and makes it suitable for the various cropping systems. The yield of the crop depends upon the interaction between external environmental factors with physiological processes of the plant. The diversification of various physiological components of growth and development is possible through the source manipulations or exogenous application of plant growth regulators, which ultimately enhancing or modifying the physiological processes in plants or tissue levels. Thus manipulation of source may provide opportunity for increasing yield in plants with excessive leaf development habit. Sink in mungbean is determined by the number of pods per plant (Mackenzie *et al*., 1975) [6], number of seeds per pod and weight of an individual seed (AVRDC, 1976) [2]. Removal of apical shoot above node 5 or removal of inflorescence or axillary bud at nodes 1-4 together with the apical shoot greatly increased pod number and seed weight of mungbean (Clifford, 1979) [3]. The leaves at flowering nodes are the major contributors for seed filling and development (AVRDC, 1974) [1]. The use of plant growth regulators are known to improve the physiological efficiency including photosynthetic ability of plants and offer a significant role in realizing higher crop yields. The PGRs are also known to enhance the source-sink relationship and stimulate the translocation of photo-assimilates, thereby increasing the productivity (Taiz and Zeiger, 2003) [9]. No detail information is available in mungbean about source-sink relationships under discriminated source levels. These aspects need investigation in mungbean genotypes to develop high yielding variety/crop management under sub-tropical condition. Hence, the present study was undertaken for studying the effect on biochemical parameters by manipulating source through nipping and artificially removal of selective leaves and also the use of plant growth regulators and chemical (GA3, NAA and Thiourea) using factorial randomized block design in two respective years 2016 and 2017.

Materials and Methods

The present investigation on "Effect of source manipulation, plant growth regulators and chemical on physiological parameters of green gram (*Vigna radiata* L. Wilckzek.) *cv*. GAM-5" was carried out at Regional Research Station, Anand Agricultural University, Anand during summer in the year 2016 and 2017. There were twenty eight treatment combinations comprising four source manipulation treatments *i.e.*, M1-Control, M2-Nipping at 30 DAS, M3-25% defoliation and M4- 50% defoliation and seven different PGR's treatments along with control *i.e.*, S1-Water spray (Control), S2- GA3 25 mg/l, S3-GA3 50 mg/l, S4-NAA 25 mg/l, S5-NAA 50 mg/l, S6-Thiourea 500 mg/l and S7-Thiourea 1000 mg/l in a Randomized Block Design (Factorial) with three replications.

1. Protein Content (%)

The Kjeldahl method was developed in 1883 by a brewer called Johann Kjeldahl. A food is digested with a strong acid so that it releases nitrogen which can be determined by a suitable titration technique. The amount of protein present is then calculated from the nitrogen concentration of the food. The same basic approach is still used today, although a number of improvements have been made to speed up the process and to obtain more accurate measurements. It is usually considered to be *the* standard method of determining protein concentration. Because the Kjeldahl method does not measure the protein content directly a *conversion factor (F)* is needed to convert the measured nitrogen concentration to a protein concentration. A conversion factor of 6.25 (equivalent to 0.16 g nitrogen per gram of protein) is used for many applications, however, this is only an average value, and each protein has a different conversion factor depending on its amino-acid composition.

2. Total Nitrogen (%)

Protein content in seeds was determined by kjeldahl method (Miller and Houghton, 1945).The method consists of heating a substance with sulphuric acid, which decomposes the organic substance by oxidation to liberate the reduced nitrogen as ammonium sulphate. In this step potassium sulphate is added to increase the boiling point of the medium (from 337 °C to 373 °C). Chemical decomposition of the sample is complete when the initially very dark-coloured medium has become clear and colourless. The solution is then distilled with a small quantity of sodium hydroxide, which converts the ammonium salt to ammonia. The amount of ammonia present, and thus the amount of nitrogen present in the sample, is determined by back titration. The end of the condenser is dipped into a solution of boric acid. The ammonia reacts with the acid and the remainder of the acid is then titrated with a sodium carbonate solution by way of a methyl orange pH indicator.

Results and Discussion

1. Protein Content (%)

The perusals of data presented in Table 1 revealed significant differences among the source manipulation and PGR"s and chemical treatments during the years 2016, 2017 and in pooled analysis. Significant differences were observed in test weight in both the respective years and pooled analysis. Significantly the maximum protein content was recorded under treatment M2 (Nipping) *i.e.*, 26.50, 26.75 and 26.63 % during individual years as well as in pooled analysis. However, the source manipulation treatments M1and M3 remained at par with each other during both the years and in pooled analysis. Differences among the PGR"s and chemical treatments showed significant during both the years and in pooled analysis for protein content. Treatment S3 (GA3 50 mg/l) registered significantly the higher protein content *i.e.*, 27.35, 26.61 and 26.98 % during both the years and in pooled analysis. While it was statistically at par with S2 (GA3 25 mg/l) treatment *i.e.*, 26.83, 26.20 and 26.51 % in both the years 2016, 2017 and in pooled analysis. However, the minimum protein content was observed under untreated control (S1) respectively. The results were in concurrence with the studies of Shukla *et al.* (2018) [8] in chickpea and Kumar *et al.* (2015) [5] in field bean.

2. Total Nitrogen (%)

The perusals of data presented in Table 2 revealed significant differences among the source manipulation and PGR"s and chemical treatments during the years 2016, 2017 and in pooled analysis. Persual of data presented indicated significant differences with respect to source manipulation in both the respective years as well as pooled analysis. It was observed that plant treated with M2 (nipping) registered highest nitrogen content M2 *i.e*., 4.24, 4.28 and 4.26 % during both the years as well as in pooled analysis and was significantly superior to the rest of the treatments including control M1 (4.21, 4.04 and 4.12 %) respectively. In response to PGRs and chemical treatments the results were found to be significant during both the respective years as well as pooled analysis. The highest total nitrogen content was recorded by the treatment GA3 50 mg/l *i.e.*, 4.38, 4.26 and 4.32 % followed by S2 *i.e*., 4.29, 4.19 and 4.24 % respectively. However, the minimum nitrogen content was recorded by untreated control treatment S1 *i.e.*, 4.07, 3.97 and 4.02 % compared to other treatments. The results were in accordance with the findings of Kumar *et al.* (2018) [4] in mungbean.

Table 1: Influence of source manipulation and plant growth regulators and chemical on protein content (%)

Protein content (%)			
Treatments	2016	2017	Pooled
Source manipulation (M)			
M1-Control	26.34	25.22	25.78
M2-Nipping at 30DAS	26.50	26.75	26.63
M3-25%defoliation	26.16	26.31	26.24
M4-50%defoliation	25.82	24.04	24.93
S. Em.+	0.07	0.13	0.08
C. D. @5%	0.19	0.36	0.21
PGR's and chemical application (S)			
S1-Control	25.43	24.80	25.11
S2-GA_3 25mg/l	26.83	26.20	26.51
S3 GA_3 50mg/l	27.35	26.61	26.98

S4-NAA 25mg/l	26.30	25.70	26.00
S5-NAA 50mg/l	26.54	25.91	26.23
S6-Thiourea 500mg/l	25.41	24.87	25.14
S7- Thiourea 100mg/l	25.58	24.99	25.28
S. Em.+	0.09	0.17	0.10
C. D. @5%	0.26	0.47	0.28
Interactions			
M×S			
S. Em.+	0.18	0.33	0.20
C. D. @5%	NS	NS	NS
Y×M			
S. Em.+			0.11
C. D. @5%			0.30
Y×S			
S. Em.+			0.14
C. D. @5%			NS
Y×M×S			
S. Em.+			0.28
C. D. @5%			NS
CV%	1.20	2.25	1.82

Table 2: Influence of source manipulation and plant growth regulators and chemical on total nitrogen (%)

Total nitrogen (%)			
Treatments	**2016**	**2017**	**Pooled**
Source manipulation (M)			
M1-Control	4.21	4.04	4.12
M2-Nipping at 30DAS	4.24	4.28	4.26
M3-25%defoliation	4.19	4.21	4.20
M4-50%defoliation	4.13	3.85	3.99
S. Em.+	0.01	0.02	0.01
C. D. @5%	0.03	0.06	0.03
PGR's and chemical application (S)			
S1-Control	4.07	3.97	4.02
S2-$GA_3$25mg/l	4.29	4.19	4.24
S3 $GA_3$50mg/l	4.38	4.26	4.32
S4-NAA 25mg/l	4.21	4.11	4.16
S5-NAA 50mg/l	4.25	4.15	4.20
S6-Thiourea 500mg/l	4.07	3.98	4.02
S7- Thiourea 100mg/l	4.09	4.00	4.05
S. Em.+	0.01	0.03	0.02
C. D. @5%	0.04	0.07	0.04
Interactions			
M×S			
S. Em.+	0.03	0.05	0.03
C. D. @5%	NS	NS	NS
Y×M			
S. Em.+			0.02
C. D. @5%			0.05
Y×S			
S. Em.+			0.02
C. D. @5%			NS
Y×M×S			
S. Em.+			0.05
C. D. @5%			NS
CV%	1.14	2.20	1.52

Conclusion

Results were found significant for biochemical parameters. The protein content and total nitrogen were significantly higher under the treatment of nipping M_2*i.e*, 26.63 and 4.26 respectively in pooled analysis. The biochemical parameters protein content and total nitrogen observed significant differences by plant growth regulators and chemical treatment. The protein content and total nitrogen was observed the maximum in treatment (S_3) GA_3 50 mg/l *i.e.*, 26.98 and 4.32 respectively which was at par with the treatment (S_2) GA_3 25 mg/l in pooled analysis.

5. References

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