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Effect of Detopping and Mepiquat Chloride Application in Soybean (*Glycine max*)

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ABSTRACT

Investigation was carried out in Punjab Agricultural University, Ludhiana, during *kharif* 2014 and 2015 to evaluate the effect of detopping and mepiquat chloride (MC) application on economics and seed quality of soybean (*Glycine max* L.) cv. SL 744. The experiment was laid-out in randomized complete block design having eight treatments as T1-control, T2- detopping (removal of 4-5 cm apical portion of main stem) at 50-55 days after sowing (DAS), T3-MC @ 200 ppm at 50-55 DAS, T4-MC @ 200 ppm at 50-55 and 65-70 DAS, T5- MC 250 ppm at 50-55 DAS, T6-MC @ 250 ppm at 50-55 and 65-70 DAS, T7-MC @ 300 ppm at 50-55 DAS and T8-MC @ 300 ppm at 50-55 and 65-70 DAS, with four replications. An increase in seed nitrogen and protein content with increase in level of MC was recorded but it could not reach the level of significance. A non-significant effect of detopping and MC application on stover nitrogen and seed oil content was also recorded. A non-significant effect of growth regulation treatments on seed quality parameters viz., germination percentage, seedling length and dry weight, vigour index I & II and speed of germination index was recorded which indicates non-inhibitory effect of MC on seed quality of soybean. Detopping and application of MC @ 250 ppm at two growth stages resulted in highest gross and net returns and benefit to cost ratio (B:C) in comparison to control indicating economical viability of detopping and MC application.

Key Words: Detopping, Growth retardant, Seed, Nitrogen, Protein, Seed quality, Soybean.

INTRODUCTION

Soybean (*Glycine max* L.) belonging to family Leguminosae has recognized as beneficial source of protein, edible oil and functional food on world level. The use of growth regulators can prove propitious in managing physiological flaws, altering the growth behaviour and quality of crops and their produce (Jaidka *et al*, 2018). As per Solamani *et al* (2001), growth regulators can improve the physiological efficiency including photosynthetic ability and can enhance the effective partitioning of accumulates from source to sink in the field crops. Application of chlormequat chloride @ 187.5 g a.i./ha resulted in significantly higher seed protein content (20.63 %) followed by mepiquat chloride 5% AS and chlormequat chloride @ 162.5 g a.i./ha (Rajesh *et al*, 2014). Application of growth regulators NAA (20ppm), cycocel (50ppm) and MH (50ppm) increased the protein content by 19.98, 17.91 and 20.65 per cent, respectively over control (water spray) in chickpea (Kumar *et al*, 2003). Patel (2010) reported highest B:C of cowpea cultivation (1:3.80) by application of gibberellic acid @ 25 mg/l. Sharma *et al* (2003) reported that highest B:C (1.98) was realized when nipping was done at 50 DAS at 90 x 10 cm spacing followed by 1.80 at 90 x 20 cm spacing regime. Singh and Devi (2006) also reported an increase in B:C in pea with highest (1.77) on nipping at 30 DAS followed by 1.76 (nipping at 35 DAS). So keeping in view the importance of plant growth regulators and detopping, present investigation was undertaken

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with the following objective to study the effect of detopping and mepiquat chloride on benefit to cost (B:C) ratio and seed quality of soybean.

MATERIALS AND METHODS

The investigation was carried out in Punjab Agricultural University, Ludhiana, during kharif season of 2014 and 2015. Ludhiana is situated at 30°54' N and 75°48' E at 247 m above mean sea level. This region is characterized with subtropical, semiarid climate. Soil of the experimental site was sandy loam with neutral soil reaction and electrical conductivity, low in organic carbon, available nitrogen, and potassium while high in available phosphorus. The experiment was laid-out in randomized complete block design having eight treatments as T1-control, T2- detopping (removal of 4-5 cm apical portion of main stem) at 50-55 days after sowing (DAS), T3-MC @ 200 ppm at 50-55 DAS, T4-MC @ 200 ppm at 50-55 and 65-70 DAS, T5- MC 250 ppm at 50-55 DAS, T6-MC @ 250 ppm at 50-55 and 65-70 DAS, T7-MC @ 300 ppm at 50-55 DAS and T8-MC @ 300 ppm at 50-55 and 65-70 DAS, with four replications. Gross and net plot size of the experiment was 10×3.15m and 8×1.35m, respectively. Sowing of soybean cv. SL744 was done on 13-06-2014 during first year and on 08-06-2015 during second year through pora method using seed @ 75 kg/ha keeping row to row and plant to plant spacing of 45 cm and 5 cm, respectively. The fertilizers were applied at the time of sowing @ 32 kg N/ha as urea and 80 kg P2O5/ha as single super phosphate. All the crop management practices were implemented as per recommandations of Punjab Agricultural University, Ludhiana.

Quality Parameters

The nitrogen content (%) of stover and seed was determined by modified Kjeldahl's method (1883). The crude protein (%) in stover as well as seed of soybean was worked out by multiplying its nitrogen content with factor of 6.25. Oil content in seed was determined by Soxhlet method (AOAC, 1965).

Seed Quality

Lab experiments for seed testing were conducted in the Seed Technology Centre, PAU, Ludhiana. Germination percentage was computed by incubating the seeds at 25°C for seven days. Normal seedlings were counted out of total germinated seeds and expressed as percentage. Germination percentage was calculated as follows:

Germination percentage = Number of normal seedlings/ Total number of seeds incubated´ 100

Seedling length of 10 randomly selected normal seedlings was measured and expressed as an average value in cm. After measuring seedling length of 10 seedlings, these were kept in oven at 110oC for 24 hr. After 24 hr, samples were kept out of oven for 30 minutes followed by measuring dry weight which was expressed in g. Vigour index I of seedlings was determined as follows:

Vigour index I= Germination Percentage× Seedling Length (cm)

Vigour index II of seedlings was determined as follows:

Vigour index II= Germination Percentage× Seedling dry weight (g)

Speed of germination index (SGI) of seeds is directly proportional to seedling vigour. Speed of germination was determined by incubating the seeds in petri plates. Data regarding number of seeds at physiological germination were recorded on daily basis for seven days. Every day the seeds which were included in observation, were removed from the total sample and SGI was determined as follows:

SGI= Number of germinated seeds/Days of first count + ……. + Number of germinated seeds/Days of final count

Benefit to Cost (B: C) Ratio

Total cost of cultivation includes variable cost of inputs like land preparation, seed and seed treatment, irrigation, fertilizer, herbicides, pesticides, human

labour, marketing charges, land interest, cost of growth regulators, detopping, defoliants and fixed cost such as land rent. B:C was calculated by using the formula as

B:C = Net returns/ Total cost of cultivation.

Statistical analysis

The various data of two years were subjected to pooled analysis by general linear model (GLM) procedure (SAS Software 9.2, SAS Institute Ltd., U.S.A.) by applying Duncan Multiple Range Test (DMRT) and Least Significant Difference (LSD) method.

RESULTS AND DISCUSSION

Nitrogen and Protein Content (%)

Pooled analysis of data (Table 1) showed a non-significant effect of detopping and mepiquat chloride applications on seed nitrogen content as compared to control. Although lowest value of seed nitrogen content was recorded in control (5.72%) yet it was non-significantly different from detopping and mepiquat chloride treatments. With increase in level of mepiquat chloride, an increase in seed nitrogen content was recorded but it could not reach the level of significance. Perusal of data on seed protein content depicted an increase in seed protein content with increase in level of mepiquat chloride but all the treatments were non-significantly different from each other over the years. Reddy *et al* (2009) in cowpea, also reported that application of lihocin (1000 ppm), mepiquat chloride (1000 ppm) and maleic hydrazide (500 ppm) resulted in enhanced seed protein content than control but any of the treatment could not reach the level of significance. Sandhu *et al* (2015) also showed a non-significant effect of growth regulators as well as detopping on the seed nitrogen and protein content of summer mungbean. Similarly, a non-significant effect of detopping and mepiquat chloride application on the stover nitrogen and protein content (Table 1) was recorded in the compound analysis.

Seed Oil Content (%)

Over the years, detopping as well as mepiquat chloride application had a non-significant effect on the seed oil content (Table 1) relative to contrast. Results showed that application of mepiquat chloride put the seed oil content on higher side than control but could not reach level of significance.

Seed Quality Parameters

The pooled analysis of data (Table 2) revealed a non-significant difference in treatments with respect to germination percentage. Investigation of data (Table 2) revealed that seed samples from the treatment in which mepiquat chloride was

Table 1. Quality parameters of soybean as affected by detopping and mepiquat chloride application.

Treatment	Seed nitrogen content (%)	Protein Content (%)	Stover nitrogen (%)	Stover protein (%)
T_1	5.72ns	35.8ns	0.85ns	5.30ns
T_2	5.80	36.2	0.85	5.29
T_3	5.76	35.9	0.85	5.28
T_4	5.80	36.2	0.85	5.32
T_5	5.78	36.2	0.85	5.28
T_6	5.69	35.6	0.85	5.28
T_7	5.72	35.7	0.85	5.31
T_8	5.7a	35.9	0.86	5.34
SEd	0.06	0.35	0.01	0.05
SEm (±)	0.01	0.09	0.002	0.01
P(F)	0.46	0.44	0.87	0.88

Table 2. Effect of detopping and mepiquat chloride application on seed quality of soybean.

Treatment	Germination Percentage (%)	Seedling Length (cm)	Seedling Dry Weight (g)	Vigour Index I	Vigour Index II	Speed of Germination Index (SGI)
T_1	75.88ns	24.61ns	0.63ns	1875.00ns	47.51ns	9.18ns
T_2	74.13	25.88	0.61	1931.10	45.20	9.08
T_3	76.13	24.91	0.65	1893.00	49.75	8.89
T_4	75.75	25.36	0.62	1921.60	46.81	9.06
T_5	76.38	25.88	0.62	1973.60	47.56	9.26
T_6	78.38	25.58	0.64	2008.10	49.93	9.12
T_7	79.63	26.24	0.62	1864.40	49.27	8.91
T_8	75.88	25.28	0.64	1919.50	48.13	9.49
SEd	1.74	0.81	0.02	116.24	1.95	0.27
SEm (±)	0.59	0.26	0.01	38.51	0.64	0.09
P(F)	0.47	0.85	0.88	0.98	0.69	0.82

applied once @ 300 ppm had the highest seedling length which was statistically at par with all other treatments. Results of pooled analysis also depicted that seedling dry weight of all seed samples from respective treatments was not significantly different from each other. Results indicate non-harmful effect of mepiquat chloride application on the performance of soybean seed in terms of seedling vigour. The highest value of vigor index I (2008.10) & vigor index II (49.93) was recorded in the seed sample received from the treatment where mepiquat chloride was applied @ 250 ppm at two growth stages but detopping and foliar application of mepiquat chloride could not reach level of significance in comparison to control. From the results it can be concluded that foliar application of mepiquat does not deteriorate the seed quality even if it is applied on the soybean seed crop.

Although the highest SGI was recorded in seed sample from treatment including two foliar applications of mepiquat chloride @ 300 ppm but it could not reach level of significance as compared to control and other treatment indicating non-hindrance of mepiquat chloride application on the seedling vigour and growth.

Benefit to cost ratio (B:C)

Mean value of B:C (Table 3) of both the crop seasons indicated that detopping gave highest net returns as compared to rest of the treatments as indicated by the highest B:C (1.44). Among mepiquat chloride treatments, two foliar applications of mepiquat chloride @ 250 ppm gave better net returns per unit of cost of cultivation (1.32) followed by single application of mepiquat chloride @ 250 ppm (1.31). B:C in two foliar applications of mepiquat chloride @ 300 ppm (1.00) was lesser than control (1.04) which indicates less feasibility of former treatment than later.

CONCLUSION

Detopping and foliar application of mepiquat chloride had a non-significant effect on nitrogen and protein content of seed and stover. Testing of seed under laboratory conditions showed a non-significant effect on the seed quality parameters viz., seed germination, seedling length, seedling dry weight, vigour index I and II, speed of germination index. Results clearly demonstrate that if mepiquat chloride is applied on soybean seed crop for regulating the growth and developmental behaviour, it will not pose any inhibitory effect on

Table 3: B: C of soybean cultivation as affected by growth regulation studies (Mean value of two years)

Treatment	Total Cost of Cultivation (Rs/ha)	Gross Returns (Rs/ha)	Net Returns (Rs/ha)	B:C
T_1	18539	37803	19264	1.04
T_2	21541	52700	31159	1.44
T_3	20638	46237	25599	1.24
T_4	23229	52039	28810	1.24
T_5	20735	47940	27205	1.31
T_6	22931	53052	30121	1.32
T_7	21052	46803	25751	1.22
T_8	23565	47127	23562	1.00

quality of soybean seed. Increase in B:C indicates economical feasibility of detopping and foliar application of mepiquat chloride @ 250 ppm at 50-55 and 65-70 DAS.

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