

DRY MATTER PARTITIONING AND SOURCE-SINK RELATIONSHIP AS INFLUENCED BY FOLIAR SPRAYS IN GROUNDNUT

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KEYWORDS

Groundnut
Source-sink
Growth regulators
Indeterminate

Received on :

15.04.2013

Accepted on :

02.10.2013

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ABSTRACT

Metabolism in plant is regulated by the exogenous growth regulating substances/PGR's which offer new avenues in combating environmental stresses, improving quality and enhancing productivity. The effect of foliar application of growth regulating substances viz. indole acetic acid (IAA @ 5 and 7.5 ppm) followed by second spray of ethrel 25 ppm, sequential spray of mepiquat chloride @ 125 ppm and mepiquat chloride @ 125 ppm + ethrel 25 ppm were visualized in two cultivars of groundnut SG-99 (bunch type) and M-13 (spreading). The impact of the foliar sprays were significant on source strength and dry matter partitioning in the two cultivars. Dry matter of pods (PDM) increased with both the concentrations of IAA in SG-99 and all the foliar sprays except IAA @ 7.5 ppm + ethrel 25 ppm in M-13. Source-sink relationship enhanced with the application of IAA @ 5 ppm + ethrel 25 ppm in SG-99 while sequential spray of mepiquat chloride @ 125 ppm, mepiquat chloride @ 125 ppm + ethrel 25 ppm in M-13 at 60 DAS. Mean pod yield (33.1%), shelling percentage (9.9%), 100 seed weight (8.9%) and oil content (1.0%) were higher in bunch type cultivar SG-99 as compared with M-13. A comparable increase in pod yield was recorded with IAA @ 7.5 ppm + Ethrel 25 ppm in SG-99 (11.8%) and M-13 (11.1%).

INTRODUCTION

Groundnut (*Arachis hypogaea*) is an important leguminous oilseed crop, which provides edible oil and protein for human beings and also fodder for livestock. Indeterminate growth habit in groundnut results in overlapping of growth and development phases of the reproductive and vegetative organs leading to low fruiting efficiency. The latter is due to inter organ competition for assimilates and other metabolites. Consequently, there is improper partitioning of assimilate to the developing pods and seeds. Most prominent constraint in the low yield is extended duration of flowering and variable pods sizes. The present study was aimed at studying the pattern of the dry matter accumulation during different phases of crop growth in cultivars with different growth habits like SG-99 (bunch type) and M-13 (spreading). In groundnut plant, translocation of photosynthates is not random but has a definite patterns as reported by Malik *et al.*, (1995) and later by Parmar *et al.* (1989) and this pattern is changed during different phases of plant growth. Partitioning of dry matter is therefore regarded as the distribution of dry matter between the organs of plant or as the distribution between different processes (e.g. synthesis and hydrolysis of sugars, export, respiration etc.). It is the end result of the flow of assimilates from source organ via a transport pathway to sink organs. The partitioning among the sinks of a plant is primarily regulated by sinks themselves. The effect of source strength on the assimilate partitioning is often not direct one, but indirect via the formation of sink organs. Although, the translocation rate of assimilate may depend on the transport path but the later is only of minor importance for the regulation of DM partitioning. Source-sink relationship and the regulation of carbon

allocation determine the crop yield. The growth of individual organs may be restricted by assimilate availability/source limitation or by organs ability to utilize assimilates/sink limitation (Patrick 1988). Source and sink limitations may be separated in time so that organ growth is primarily source linked at certain periods during development and primarily sink limited at other time (Sharma and Sardana, 2012).

Growth regulating substances/growth regulators are known to influence a wide array of physiological parameters like alteration of plant archetype, assimilate partitioning, promotion of photosynthesis, uptake of mineral ions, enhancing nitrogen metabolism, promotion of flowering, uniform pod formation, increased mobilization of assimilates to defined sinks, improved seed quality, induction of synchrony in flowering and delayed senescence of leaves. Malik (1995) in his presidential address has detailed plant growth regulators as software for plant development and crop productivity. The response of groundnut varieties to different growth regulators, aliphatic alcohols, phenolic compounds etc. varies and for details references can be made to the studies of Parmar *et al.* (1989, 2003), Sharma and Malik (1994), Verma *et al.* (2008, 2009) and Sharma and Sardana (2012). Further Verma *et al.* (2008, 2009) have investigated the role of some PGR's on crop productivity. Several studies earlier too have demonstrated the effect of growth regulators in altering several physiological traits and hence yield (Malik *et al.*, 1990, 1995). The importance of PGR's in source and sink relationship leading to enhanced translocation of photo assimilates has been well documented by Menon and Srivastava (1984). Wang *et al.*, (1995) and later Parmar *et al.* (2003) have demonstrated in their field studies the application of mepiquat

chloride decreased partitioning of photo assimilates to the main stem, branches but increased the mobilization of assimilates into the reproductive sinks. Sharma and Malik (1994) used three PGR's to investigate chemical regulation of carbon acquisition in groundnut. Recently Sharma and Sardana (2012) have demonstrated the influence of indole acetic acid, mepiquat chloride and ethrel in different combinations on productivity by enhancing the nitrate reductase and leghaemoglobin content. Growth regulators can improve the physiological efficiency including photosynthetic ability and can enhance effective partitioning of the accumulates from the sink to the source in the field crops (Solaimalai *et al.*, 2001). Foliar application of the growth regulators and chemicals at the flowering stage may improve the physiological efficiency and may play a significant role in raising the productivity of the crop (Dashora and Jain, 1994) The intent of the present investigation was to study extensively the impact of growth regulators on pattern of dry matter accumulation, mobilization, partitioning and ultimately on source-sink relationship. Further to visualize the effect of PGR's on yield components particularly uniform development of pods for enhancing productivity.

MATERIALS AND METHODS

Field experiments were conducted at Punjab Agricultural University, Ludhiana, India (30°54N,75° 56E.472m above mean sea level) during summer season of 2006 and 2007 to study the effect of growth regulating substances on dry matter accumulation, partitioning and ultimately on the productivity of groundnut. Four treatments, seven rows each of 5 meter row length were sown at spacing of 30 × 15 cm. Two cultivars SG-99 (bunch type) and M-13 (spreading) were sown on 11th July, 2006 and 9th June, 2007. The recommended package of practices (except treatments) was followed to raise the crop. The first spray was given at 40 days after sowing (DAS) followed by sequential application at 50 DAS in the following combinations:

T₁ : IAA @ 5 ppm + ethrel 25 ppm

T₂ : IAA @ 7.5 ppm + ethrel 25 ppm

T₃ : Mepiquat chloride @ 125 ppm + mepiquat chloride 125 ppm

T₄ : Mepiquat chloride @ 125 ppm + ethrel 25 ppm

T₅ : Water spray

T₆ : Control (no spray)

Growth parameters and dry matter partitioning into different plant parts were recorded at 40 and 50 DAS and the impact of foliar applications were visualized at 60 DAS on dry matter and source-sink relationship. At physiological maturity five randomly selected plants per replicate from each treatment were used for recording growth traits and yield components with categorization of mature/fully developed pods, immature pods and gynophores. Pod yield was computed on hectare basis. The data was analyzed by CPCS (2008) software package in factorial RBD and figures were drawn using excel.

RESULTS AND DISCUSSION

Growth and dry matter before foliar sprays

Plant height, root length and number of pegs were higher in SG-99 at 40DAS whereas the number of primary, secondary branches, nodules and the leaves/source were higher in M-13. Non significant differences in growth traits were observed within the two cultivars at 50 DAS. At this stage (50 DAS) however; similar trend was recorded in growth parameters as at 40 DAS except with the higher number of pegs without pods in M-13 (Fig. 1). Total dry matter was higher in SG-99 at 40 DAS. Maximum dry weight was in the leaves (3.85 g) followed by shoot (2.99 g), root (0.531 g) and least in nodules (0.289 g). Dry weight of shoot in M-13 was comparable with that of SG-99 but the DW of root, nodules and leaves were lower in M-13. Non-significant differences were registered for total dry matter (TDM) production in both the cultivars at 50 DAS. Partitioning of dry matter followed a similar trend as at 40 DAS. Root and nodules had higher dry matter accumulation in M-13 a spreading type of cultivar as compared with the SG-99, a bunch type cultivar (Fig. 2). This could be attributed to more allocation of assimilates to developing roots which

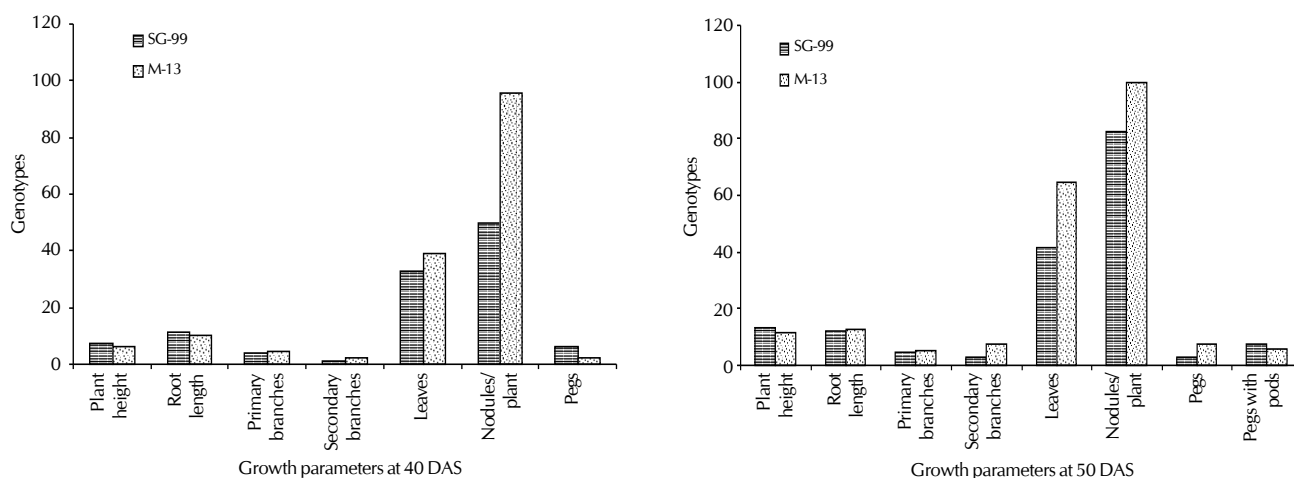


Figure 1: Changes in growth parameters during crop growth in groundnut cultivars at 40 and 50 DAS

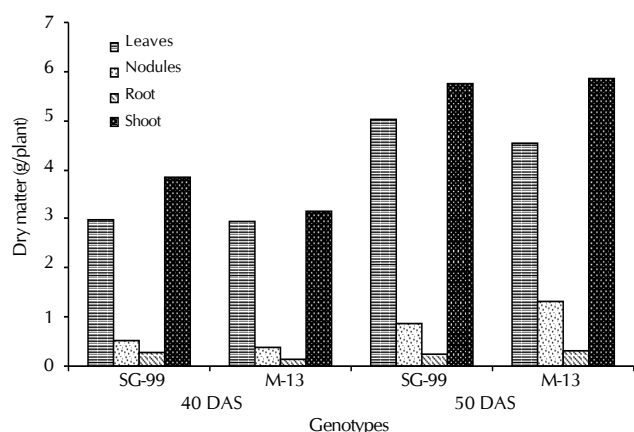


Figure 2: Partitioning of dry matter into different plant parts at two stages of crop growth

enhances root volume and weight of the nodules thereby increasing the uptake of nutrients (Poorter and Nagel, 2007).

Impact of foliar sprays on growth traits

Plant height increased significantly with IAA @ 7.5 ppm + ethrel 25 ppm (13.9%) and sequential spray of mepiquat chloride @ 125 ppm (8.6%) in SG-99 whereas non significant differences were recorded in M-13. Root length also showed non-significant variation with the foliar sprays. However, 6.3% increase in root length was recorded with sequential spray of mepiquat chloride @ 125 ppm in SG-99 whereas root length was comparable in M-13 with control. Number of primary branches varied significantly in SG-99 with IAA @ 5 ppm + ethrel 25 ppm and mepiquat chloride @ 125 ppm + ethrel 25 ppm whereas in M-13 it was with both the concentration of

IAA followed by the second spray of ethrel @ 25 ppm. Number of primary branches were comparable in sequential spray of Mepiquat chloride @ 125 ppm and mepiquat chloride @ 125 ppm + ethrel 25 ppm treatments in the spreading cultivar. Numbers of secondary branches were significantly higher in SG-99 with IAA @ 5 ppm + ethrel 25 ppm and in cultivar M-13 all the foliar sprays were beneficial except mepiquat chloride @ 125 ppm + ethrel 25 ppm. The increase in number of branches with gibberellic acid has been reported in many crops by Tanimoto (1990), Sontakey *et al.* (1991) and Deotale *et al.* (1998). Number of leaves (source strength) were higher with IAA @ 7.5 ppm + ethrel 25 ppm and water spray in SG-99. However, significantly higher numbers of leaves were registered with both the concentrations of IAA and water spray in M13. Sujatha (2001) reported the foliar spray of salicylic acid on green gram at 75 DAS increased the plant height, root length, number of leaves and LAI. Similar effect has also been reported on baby corn by Nagasubramanian *et al.* (2007) and in groundnut by Yakuba *et al.* (2013). Number of nodules were significantly higher with IAA @ 5 ppm + ethrel 25 ppm, IAA @ 7.5 ppm + ethrel 25 ppm and mepiquat chloride @ 125 ppm + ethrel 25 ppm in cultivar M-13. Number of pegs without pods were higher with both the IAA concentrations (5 and 7.5 ppm) in SG-99 whereas mepiquat chloride @ 125 ppm + ethrel 25 ppm registered higher number of pegs without pods in M-13 and were comparable in IAA @ 5 ppm + ethrel 25 ppm and control. All the foliar sprays increased the number of pegs with pods in M-13 only (Table 1). Application of a third spray at 60 DAS may be beneficial in mobilization of assimilates towards the developing pegs with the pods for pod filling and improving productivity.

Table 1: Growth traits and yield attributes at 60 DAS

No.	Treatments	Plant height (cm)		Pri. br.		Sec. br.		No. of leaves		Nodules/plant		Root length (cm)		Pegs without pods		Pegs with pods	
		SG-99	M-13	SG-99	M-13	SG-99	M-13	SG-99	M-13	SG-99	M-13	SG-99	M-13	SG-99	M-13	SG-99	M-13
T ₁	IAA @ 5 ppm + ethrel 25 ppm	18.7	13.1	4.6	6.2	3.6	12.2	64.1	140.1	91.9	242.1	9.3	10.7	11.7	9.7	8.4	23.6
T ₂	IAA @ 7.5 ppm + ethrel 25 ppm	21.2	11.9	4.2	6.3	3.1	11.6	72.1	135.9	98.8	310.2	9.8	9.9	11.4	9.8	8.7	20.9
T ₃	Mep. chloride @ 125 ppm + mep. chloride 125 ppm	20.2	13.2	4.0	5.6	2.2	10.8	37.4	108.6	79.6	160.9	10.4	10.4	7.9	9.1	8.8	15.6
T ₄	Mep. chloride @ 125 ppm + ethrel 25 ppm	18.6	12.7	4.7	5.6	2.7	8.6	64.8	112.2	107.7	195.9	8.8	10.2	9.9	15.3	8.1	17.9
T ₅	Water spray	16.1	12.8	4.3	5.4	2.2	9.1	70.3	122.9	69.1	146.6	9.1	10.1	9.6	8.8	6.9	17.7
T ₆	Control	18.6	15.7	4.0	4.9	1.8	7.1	62.4	99.4	68.3	143.1	9.6	10.9	8.8	9.7	8.3	14.8
Mean		18.9	13.2	4.3	5.7	2.5	9.9	61.9	119.8	85.9	198.3	9.51	10.4	9.9	10.4	8.2	18.4
C.D @ 5%	Gen (G)	1.4		0.3		1.4		15.2		29.2		NS		NS		2.37	
	Spray (S)	NS		0.553		NS		NS		50.6		NS		2.26		NS	
	G x S	NS		NS		NS		NS		71.6		NS		3.20		NS	

Table 2: Influence of growth regulators on dry matter partitioning (g/plant) and source-sink relationship in groundnut cultivars at 60 DAS

No.	Treatments	Root		Nodules		Shoot		Leaves		Pods		Total dry matter		Source-sink relationship	
		SG-99	M-13	SG-99	M-13	SG-99	M-13	SG-99	M-13	SG-99	M-13	SG-99	M-13	SG-99	M-13
T ₁	IAA @ 5 ppm + ethrel 25 ppm	0.443	0.906	0.121	0.280	5.94	9.15	6.25	8.37	2.66	0.582	15.4	19.3	0.423	0.068
T ₂	IAA @ 7.5 ppm + ethrel 25 ppm	0.446	0.713	0.128	0.233	6.84	9.22	6.96	7.90	2.44	0.190	16.8	18.3	0.350	0.025
T ₃	Mep. chloride @ 125 ppm + mep. chloride 125 ppm	0.449	0.536	0.129	0.177	4.98	7.89	5.41	7.38	1.57	0.946	12.5	16.9	0.299	0.134
T ₄	Mep. chloride @ 125 ppm + ethrel 25 ppm	0.473	0.554	0.144	0.173	7.27	8.43	5.94	6.40	1.46	0.962	15.3	16.5	0.245	0.150
T ₅	Water spray	0.504	0.794	0.142	0.187	8.07	11.02	6.10	8.47	2.23	1.27	17.0	21.7	0.366	0.149
T ₆	Control	0.451	0.725	0.213	0.172	7.00	10.0	5.81	8.34	2.11	0.119	15.6	19.4	0.378	0.0156
Mean		0.451	0.704	0.146	0.203	6.68	9.29	6.07	7.82	2.07	0.679	15.4	18.7	0.343	0.0904
CD 5%	Gen (G)	0.325		0.151		0.457		0.484		0.201		0.880		0.0249	
	Spray (S)	0.562		0.262		0.792		0.838		0.349		1.52		0.043	
	G x S	0.796		0.371		NS		NS		0.494		NS		0.061	

Dry matter partitioning

Dry weight of roots showed 11.8% increase with water spray (T₅) in SG-99 and 24.9% with Mepiquat chloride @ 125 ppm + ethrel 25 ppm (T₄) and 9.5% water spray(T₅) in M-13. Decline in root dry weight was recorded with all the foliar sprays in bunch type cultivar SG-99. Cultivars with low allocation of dry matter to roots were able to sustain not only good shoot growth but also extracted a substantial amount of water from soil during crop season (Singh and Singh 1982, Sharma 2012). Passioura (1986) had also suggested that root system of many crop plants might be unnecessarily large if they were smaller more assimilate would be available for shoots. There are also mounting evidences that roots consume much more, perhaps twice as much assimilate in the production of unit DM than shoots (Passioura 1983). However, significant increase in nodule DW was with IAA @ 5 ppm + ethrel 25 ppm (T₁: 2.7%) and IAA @ 7.5 ppm + ethrel 25 ppm (T₂: 35.5%). The higher root nodule weight with the foliar sources in this study was attributed to increased plant growth and translocation to developing nodules. Further nitrate reductase and leghaemoglobin content was higher with these foliar sprays as reported by Sharma and Sardana (2012). Significant increase in dry matter of shoots with water spray (T₅) was observed in SG-99 (15.3%) and M-13(10.2%). Rest of the treatments led to decline in dry mass indicating mobilization of assimilates towards developing sinks. Two genotypes of groundnut differed in DM accumulation in leaves. Farrar (1992) interpreted source strength exerted only a coarse but not fine control over dry matter partitioning. Only IAA @ 7.5 ppm + ethrel 25 ppm (T₂) treatment led to increase in leaf dry matter in SG-99. Dry matter of pods increased with IAA @ 5 ppm + ethrel 25 ppm(T₁) and IAA @ 7.5 ppm + ethrel 25 ppm (T₂) in SG-99 .Whereas all the treatments except IAA @ 7.5 ppm + ethrel 25 ppm (T₂) led to increase in pod dry matter (PDM) in M-13. Significant differences existed between the two cultivars for DM partitioning and also with the foliar sprays .Interaction effects of cultivar × foliar sprays were significant for DM

accumulation in roots, nodules and pods. In SG-99 foliar application of IAA @ 5 ppm + ethrel 25 ppm (T₁) depicted a strong source-sink relationship at 60 DAS while sequential spray of mepiquat chloride (T₃), mepiquat chloride @ 125 ppm + ethrel 25 ppm (T₄) (T₅) showed similar trend in M-13. Foliar sprays enhanced translocation of assimilates towards the desirable sinks (pods) as compared with the control. Similar results have been reported by Mondal (2007) in mungbean. Dry matter production increased with the application of Salicylic acid in black gram (Jeyakumar *et al.*, 2008), baby corn (Nagasubramaniam *et al.*, 2007)

At physiological maturity

Plant strand varied in the two cultivars in the present investigation Plant height improved with IAA @ 7.5 ppm + ethrel 25 ppm (23.5%) and mepiquat chloride @ 125 ppm + ethrel 25 ppm(26%) in SG-99 and with water spray (15.3%) in M-13. Number of primary branches increased by 5.4% IAA @ 7.5 ppm + ethrel 25 ppm and 2.6% with mepiquat chloride @ 125 ppm + mepiquat chloride 125 ppm (T₃) in SG-99 and 10.1% with IAA @ 5 ppm + ethrel 25 ppm (T₁) and by 2.2% water spray(T₅). Number of secondary branches were higher by 9.1% (IAA @ 5 ppm + ethrel 25 ppm T₁) and 13.6% (mepiquat chloride @ 125 ppm + ethrel 25 ppm T₄) in M-13. Improvement in plant height has been reported with salicylic acid in black gram (Jeykumar *et al.*, 2008), green gram (Sujatha, 2001)and both in plant height and in number of branches with gibberallic acid in groundnut (Yakuba *et al.*, 2013).

Categorization of pods

Significant variation existed for the number of mature pods, immature pods and gynophores within the two genotypes. Foliar sprays proved to be non significant for increasing the number of mature pods and gynophores but showed significant improvement in number of immature pods. Number of mature pods improved with sequential spray of mepiquat chloride @ 125 ppm in SG-99. Number of immature pods

Table 3: Effect of growth regulators on growth characteristics and yield component at physiological maturity

No. Treatments	Plant strand/ plot		Plant height (cm)		Primary branches		Secondary branches		No. of mature pods		Immature pods		Gynophores	
	SG-99	M-13	SG-99	M-13	SG-99	M-13	SG-99	M-13	SG-99	M-13	SG-99	M-13	SG-99	M-13
T ₁ IAA @ 5 ppm + ethrel 25 ppm	600	388.7	22.9	16.8	4.86	6.53	2.4	10.7	9.4	26.1	5.6	19.3	6.0	17.4
T ₂ IAA @ 7.5 ppm + ethrel 25 ppm	606	436.3	25.2	15.3	5.27	5.73	1.7	8.5	14.7	25.2	5.1	14.6	5.1	14.1
T ₃ Mep. chloride @ 125 ppm + mep. chloride 125 ppm	629.7	428.0	22.5	16.2	5.13	6.0	1.9	8.3	16.4	23.1	5.3	13.0	6.0	14.2
T ₄ Mep. chloride @ 125 ppm + ethrel 25 ppm	593.7	514.7	24.7	16.0	4.66	5.86	2.5	9.6	13.9	23.0	5.3	14.4	5.8	13.3
T ₅ Water spray	580	409.0	19.0	18.1	4.73	6.06	1.9	9.1	14.0	25.7	4.7	18.5	4.8	21.7
T ₆ Control	601.7	506.7	20.0	15.7	5.00	5.93	2.2	9.3	14.0	22.7	5.3	16.5	5.3	17.3
Mean	601.9	447.3	26.9	16.4	4.94	6.02	2.1	9.3	13.7	24.3	5.22	16.1	5.5	16.3
CD 5%														
	Gen (G)		2.01		0.356		0.556		3.08		1.13		1.60	
	Spray (S)		NS		NS		0.965		NS		1.96		NS	
	G × S		NS		NS		NS		NS		2.77		3.92	

Table 4: Yield and yield components as influenced by foliar sprays

No. Treatments	Shelling %		Seed weight (g)		Yield (kg/ha)		Oil content (%)	
	SG-99	M-13	SG-99	M-13	SG-99	M-13	SG-99	M-13
T ₁ IAA @ 5 ppm + ethrel 25 ppm	68.6	61.7	59.0	53.8	2532.4	1755.5	49.1	48.2
T ₂ IAA @ 7.5 ppm + ethrel 25 ppm	69.0	61.8	62.7	56.5	2722.2	2077.8	47.5	48.3
T ₃ Mep. chloride @ 125 ppm + mep. chloride 125 ppm	67.3	59.9	62.0	56.7	2621.2	2111.1	47.1	48.9
T ₄ Mep. chloride @ 125 ppm + ethrel 25 ppm	68.3	65.9	60.8	56.3	2635.1	1972.2	48.7	47.7
T ₅ Waterspray	67.9	63.7	59.3	54.7	2740.6	2046.3	48.0	47.7
T ₆ Control	68.4	63.3	60.3	57.5	2434.9	1870.3	49.1	45.8
Mean	68.3	62.7	60.9	55.9	2614.4	1963.9	48.3	47.8
CD 5%	2.17	1.56	1.91	1.02	94.9	170.8	NS	NS

have significantly enhanced with the foliar application IAA @ 5 ppm + ethrel 25 ppm (16.9%) and water spray (12.1%) in M-13. In SG-99 treatment IAA @ 5 ppm + ethrel 25 ppm improved gynophores by 13.2% and mepiquat chloride @ 125 ppm + ethrel 25 ppm by 9.4% while in cultivar M-13 an increase of 25.4% was registered with water spray. Interactions between genotype \times foliar sprays (G \times S) were significant for immature pods and gynophores. Mean pod yield (33.1%), shelling percentage (9.9%), 100 seed weight (8.9%), and oil content (1.0%) were higher in SG-99 as compared to M-13. Pod yield improved in SG-99 with IAA @ 7.5 ppm + ethrel 25 ppm (11.8%), sequential spray of mepiquat chloride (7.7%), mepiquat chloride @ 125 ppm + ethrel 25 ppm (8.2%) over control. A comparable increase in yield has been recorded with IAA @ 7.5 ppm + ethrel 25 ppm (11.1%) in M-13. However other treatments were also beneficial in yield enhancement viz. mepiquat chloride @ 125 ppm + mepiquat chloride 125 ppm (12.9%), mepiquat chloride @ 125 ppm + ethrel 25 ppm (5.5%). Shelling percentage was 4.1% higher with mepiquat chloride @ 125 ppm + ethrel 25 ppm in M-13. 100 seed weight improved by 3.9% with IAA @ 7.5 ppm + ethrel 25 ppm and 2.8% with sequential application of mepiquat chloride @ 125 ppm in SG-99. Oil content enhanced by 6.8% with mepiquat chloride @ 125 ppm + mepiquat chloride 125 ppm followed by 5.5% increase with IAA @ 7.5 ppm + ethrel 25 ppm in M-13. Oil content was comparable in IAA @ 5 ppm + ethrel 25 ppm and control in SG-99. Genotypes differed significantly in source-sink relationship and foliar sprays had profound effect on this relationship. Application of IAA @ 5 ppm + ethrel 25 ppm improved this relationship in bunch type cultivar whereas both the concentrations of IAA enhanced it in spreading cultivar. Foliar sprays of growth regulating substances have altered the source-sink relationship for diverting the assimilate to the desirable sinks i.e. more number of filled /mature pods (Sharma and Sardana, 2012). Foliar sprays of aliphatic alcohols had stimulated the mobilization of photosynthates to the kernels (Verma *et al.*, 2008 and 2009). Maximum increase in the pod yield was observed with 10 ppm brassinolide (1935 kg/ha) and 30 ppm SA at reproductive stage by Mandavia *et al.* (2012). Gibberellic acid was observed to enhance growth and yield in groundnut (Yakuba *et al.*, 2013) and the optimum level as shown by regression analysis was 172.7 mg L⁻¹ on the wet season and 161.4 mg L⁻¹ in the dry season. Foliar feeding with salicylic acid has increased yield and yield components as reported in maize (Shehate *et al.*, 2001), Abdel Waheed *et al.*, 2006), wheat (Shakirova *et al.*, 2003; Iqbal and Ashraf 2006) and in groundnut (Jayalakshmi *et al.*, 2010; Sharma and Sardana, 2012).

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