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 Parmar et al. (1990, 1995). 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

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%).

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Dry matter partitioning and source-sink relationship
as influenced by foliar sprays in groundnut

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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%).

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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°54’N, 75°56’E, 472 m 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 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
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 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 whereas  root length showed increased in root length was recorded with sequential spray of 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 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

<table>
<thead>
<tr>
<th>No.</th>
<th>Treatments</th>
<th>Plant height (cm)</th>
<th>Pri. br</th>
<th>Sec. br</th>
<th>No. of leaves</th>
<th>Nodules/plant</th>
<th>Root length (cm)</th>
<th>Pegs without pods</th>
<th>Pegs with pods</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>IAA @ 5 ppm + ethrel 25 ppm</td>
<td>18.7</td>
<td>13.1</td>
<td>4.6</td>
<td>6.2</td>
<td>3.6</td>
<td>12.2</td>
<td>64.1</td>
<td>140.1</td>
</tr>
<tr>
<td>T2</td>
<td>IAA @ 7.5 ppm + ethrel 25 ppm</td>
<td>21.2</td>
<td>11.9</td>
<td>4.2</td>
<td>6.3</td>
<td>3.1</td>
<td>11.6</td>
<td>72.1</td>
<td>135.9</td>
</tr>
<tr>
<td>T3</td>
<td>Mep. chloride @ 125 ppm + mep. chloride 125 ppm</td>
<td>20.2</td>
<td>13.2</td>
<td>4.0</td>
<td>5.6</td>
<td>2.2</td>
<td>10.8</td>
<td>37.4</td>
<td>108.6</td>
</tr>
<tr>
<td>T4</td>
<td>Mep. chloride @ 125 ppm + ethrel 25 ppm</td>
<td>18.6</td>
<td>12.7</td>
<td>4.7</td>
<td>5.6</td>
<td>2.7</td>
<td>8.6</td>
<td>64.8</td>
<td>112.2</td>
</tr>
<tr>
<td>T5</td>
<td>Water spray</td>
<td>16.1</td>
<td>12.8</td>
<td>4.3</td>
<td>5.4</td>
<td>2.2</td>
<td>9.1</td>
<td>70.3</td>
<td>122.9</td>
</tr>
<tr>
<td>T6</td>
<td>Control</td>
<td>18.6</td>
<td>15.7</td>
<td>4.0</td>
<td>4.9</td>
<td>1.8</td>
<td>7.1</td>
<td>62.4</td>
<td>99.4</td>
</tr>
</tbody>
</table>

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, NS, 0.043, 0.061

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

<table>
<thead>
<tr>
<th>No. Treatments</th>
<th>Root</th>
<th>Nodules</th>
<th>Shoot</th>
<th>Leaves</th>
<th>Pods</th>
<th>Total dry matter</th>
<th>Source-sink relationship</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>IAA @ 5 ppm + ethrel 25 ppm</td>
<td>0.443</td>
<td>0.906</td>
<td>0.121</td>
<td>0.280</td>
<td>5.94</td>
<td>9.15</td>
</tr>
<tr>
<td>T2</td>
<td>IAA @ 7.5 ppm + ethrel 25 ppm</td>
<td>0.446</td>
<td>0.713</td>
<td>0.128</td>
<td>0.231</td>
<td>6.84</td>
<td>9.22</td>
</tr>
<tr>
<td>T3</td>
<td>Mep. chloride @ 125 ppm + mep. chloride 125 ppm</td>
<td>0.449</td>
<td>0.536</td>
<td>0.129</td>
<td>0.177</td>
<td>4.98</td>
<td>7.89</td>
</tr>
<tr>
<td>T4</td>
<td>Mep. chloride @ 125 ppm + ethrel 25 ppm</td>
<td>0.473</td>
<td>0.554</td>
<td>0.144</td>
<td>0.173</td>
<td>7.27</td>
<td>8.43</td>
</tr>
<tr>
<td>T5</td>
<td>Water spray</td>
<td>0.504</td>
<td>0.794</td>
<td>0.142</td>
<td>0.187</td>
<td>8.07</td>
<td>11.02</td>
</tr>
<tr>
<td>T6</td>
<td>Control</td>
<td>0.451</td>
<td>0.725</td>
<td>0.123</td>
<td>0.172</td>
<td>7.00</td>
<td>10.00</td>
</tr>
</tbody>
</table>

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Figure 2: Partitioning of dry matter into different plant parts at two stages of crop growth
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 (T2) and 9.5% with 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 to the same extent 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 (T5) 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. Number of primary branches increased by 5.4% IAA @ 5 ppm + ethrel 25 ppm and 2.6% with mepiquat chloride @ 125 ppm + ethrel 25 ppm (T4) in SG-99 and with water spray (15.3%) in M-13. Number of primary branches increased by 5.4% IAA @ 5 ppm + ethrel 25 ppm and 2.2% with 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 T1) in M-13. Improvement in plant height has been reported with salicylic acid in black gram (Jayakumar et al., 2008), green gram (Sujatha, 2001) 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 accumulation in roots, nodules and pods. In SG-99 foliar application of IAA @ 5 ppm + ethrel 25 ppm (T1) depicted a strong source-link relationship at 60 DAS while sequential spray of mepiquat chloride (T1), mepiquat chloride @ 125 ppm + ethrel 25 ppm (T2) 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 (Jayakumar et al., 2008), baby corn (Nagasubramanian 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 @ 5 ppm + ethrel 25 ppm and 2.2% with 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 T1) in M-13. Improvement in plant height has been reported with salicylic acid in black gram (Jayakumar et al., 2008), green gram (Sujatha, 2001) and in number of branches with gibberallic acid in groundnut (Yakuba et al., 2013).

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

<table>
<thead>
<tr>
<th>No. Treatments</th>
<th>Plant strand</th>
<th>Plant height</th>
<th>Primary branches</th>
<th>Secondary branches</th>
<th>No. of mature pods</th>
<th>Immature pods</th>
<th>Gynophores</th>
</tr>
</thead>
<tbody>
<tr>
<td>SG-99 M-13</td>
<td>600</td>
<td>229</td>
<td>16.8</td>
<td>4.86</td>
<td>6.53</td>
<td>2.4</td>
<td>10.7</td>
</tr>
<tr>
<td>T1 IAA @ 5 ppm + ethrel 25 ppm</td>
<td>606</td>
<td>236</td>
<td>15.3</td>
<td>5.27</td>
<td>5.37</td>
<td>1.7</td>
<td>8.5</td>
</tr>
<tr>
<td>T2 IAA @ 7.5 ppm + ethrel 25 ppm</td>
<td>629.7</td>
<td>482.0</td>
<td>16.2</td>
<td>5.13</td>
<td>6.0</td>
<td>1.9</td>
<td>8.3</td>
</tr>
<tr>
<td>T3 Mep. chloride @ 125 ppm + mep. chloride 125 ppm</td>
<td>593.7</td>
<td>514.7</td>
<td>17.0</td>
<td>4.66</td>
<td>5.86</td>
<td>2.5</td>
<td>9.6</td>
</tr>
<tr>
<td>T4 Mep. chloride @ 125 ppm + ethrel 25 ppm</td>
<td>580</td>
<td>409.0</td>
<td>18.1</td>
<td>4.71</td>
<td>6.06</td>
<td>1.9</td>
<td>9.1</td>
</tr>
<tr>
<td>T5 Water spray</td>
<td>601.7</td>
<td>506.7</td>
<td>20.0</td>
<td>5.00</td>
<td>5.93</td>
<td>2.2</td>
<td>9.3</td>
</tr>
<tr>
<td>Mean</td>
<td>601.9</td>
<td>447.3</td>
<td>26.9</td>
<td>4.94</td>
<td>6.02</td>
<td>2.1</td>
<td>9.3</td>
</tr>
<tr>
<td>CD % Gen (G)</td>
<td>47.2</td>
<td>2.01</td>
<td>0.356</td>
<td>0.556</td>
<td>3.08</td>
<td>1.13</td>
<td>1.60</td>
</tr>
<tr>
<td>CD % Spray (S)</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>0.965</td>
<td>1.96</td>
<td>NS</td>
</tr>
<tr>
<td>G x 5</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>2.77</td>
<td>3.92</td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>No. Treatments</th>
<th>Shelling %</th>
<th>Seed weight (g)</th>
<th>Yield (kgf/ha)</th>
<th>Oil content (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SG-99 M-13</td>
<td>68.6</td>
<td>61.7</td>
<td>59.0</td>
<td>15.5</td>
</tr>
<tr>
<td>T1 IAA @ 5 ppm + ethrel 25 ppm</td>
<td>69.0</td>
<td>61.8</td>
<td>62.7</td>
<td>56.5</td>
</tr>
<tr>
<td>T2 IAA @ 7.5 ppm + ethrel 25 ppm</td>
<td>67.3</td>
<td>59.9</td>
<td>62.0</td>
<td>56.7</td>
</tr>
<tr>
<td>T3 Mep. chloride @ 125 ppm + mep. chloride 125 ppm</td>
<td>68.3</td>
<td>65.9</td>
<td>60.8</td>
<td>56.3</td>
</tr>
<tr>
<td>T4 Mep. chloride @ 125 ppm + ethrel 25 ppm</td>
<td>67.9</td>
<td>61.7</td>
<td>59.3</td>
<td>54.7</td>
</tr>
<tr>
<td>T5 Water spray</td>
<td>68.4</td>
<td>63.3</td>
<td>60.3</td>
<td>57.5</td>
</tr>
<tr>
<td>Mean</td>
<td>68.3</td>
<td>62.7</td>
<td>60.9</td>
<td>55.9</td>
</tr>
<tr>
<td>CD %</td>
<td>2.17</td>
<td>1.56</td>
<td>1.91</td>
<td>1.02</td>
</tr>
</tbody>
</table>

PUSHP SHARMA et al., 1174
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 × foliar sprays (G × 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 chloride25 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 25 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 brassionilde (1935 kg/ha) and 30 ppm SA at reproductive stage by Mandavia et al. (2012). Gibberelic 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).

REFERENCES


hormonal status of wheat seedling induced by salicylic acid and salinity. *Plant Sci.* **164**:317.

Sharma, P. 2012. Mungbean seed yield: Effect of dry matter distribution, partitioning and leaf area at different crop growth stages. *(submitted to Bangladesh J. of Bot.)*


