Influence of pre-flowering pinching and Maleic hydrazide spray on plant growth, seed yield and quality attributes in fenugreek

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Received: 03-08-2013 Accepted: 29-04-2014 DOI:10.5958/0976-0571.2015.00097.1

ABSTRACT

Apical pinching and application of growth retardant Maleic hydrazide (MH) to enhance seed yield in fenugreek during rabi, 2006 revealed that among the pinching treatments, non-pinched plants (T1) recorded significantly higher plant height at 60 DAS (41.24cm) and at harvest (59.69cm). Seed yield attributes like number of pods per plant, pod weight per plant and pod weight per hectare were significantly higher (46.65, 28.93g and 3214kg, respectively) in T3 (MH @ 500ppm). However, seed yield per plant and seed yield per hectare was significantly higher in T2 over T1 and T3 (16.36, 20.07g and 2230kg, respectively). Seed quality attributes like germination (95.40%), seedling vigour index-I (2271), seedling vigour index-II (1584) and field emergence (87.20%) were superior in seeds obtained from pinched plants with lower electrical conductivity (126 dSm–1). Therefore, apical pinching could be advocated to the fenugreek in order to obtain higher seed yield with better quality.

Key words: Apical pinching, Fenugreek, Maleic hydrazide spray, Seed yield, Seed quality.

INTRODUCTION

Fenugreek is one of the oldest cultivated spices. The leaves are rich in minerals(1.5 g), vitamin A (6450 IU), vitamin C (54 mg) and protein (4.4 g) per 100 g of edible portion. Seeds are rich in protein (6.3%), fat (9.5%), carbohydrates (42.30%), vitamin A (1040 IU), calories (370/100g), gums (22.06%), mucilage (28%), trigonellin (0.13-0.35%), diosgenin (1g), gitogenin (0.1g) and traces of trigonolin per kg of dried seeds (Aykroyd, 1963). Among several seed production approaches, apical bud pinching and application of growth hormones are found to increase the seed yield and quality of leafy vegetables. In fenugreek, apical bud pinching helps in altering the source-sink relationship by curbing the vegetative growth and hastening the reproductive phase (Mehta et al., 1995). It also helps in production of more side shoots or branches thus resulting in increased photosynthetic activity and accumulation of more photosynthates ultimately resulting in increased seed size and yield (Thakral et al., 1991). Whereas, growth regulators offer unique opportunities of scaling many plants to any size and alter many physiological processes in plant to increase seed yield and quality (Alagukannan and Vijaykumar, 1999a). Among several growth hormones, GA3, TIBA and Maleic hydrazide are known to regulate the plant growth in leafy vegetables.

Apical bud pinching is one of the most important cultural practices in fenugreek which results in increase number of branches. Knowledge on this aspect is of paramount importance to manipulate the plant phenology which may eventually lead to maximum production. Growth regulators play an important role in regulating the physiological process and balancing the source-sink relationship thereby increase in productivity and quality of resultant crop. Therefore, an attempt was made to find out the effect of foliar application of maleic hydrazide on crop growth, seed yield and quality of fenugreek cv. Pusa Early Bunching.

MATERIALS AND METHODS

A field experiment was taken up during rabi 2006 (sown on 12th November 2006 and harvested on 25th February 2007) at the Agricultural Research Station, Balajigapade, Chikkaballapura, Karnataka. The topography of the experimental site was fairly uniform with little gradient towards northern side. The soil type of the experimental plot was red sandy clay loam with pH 6.3 with fairly good fertility.

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The experiment was carried out with fenugreek cv. Pusa Early Bunching (PEB) involving four treatments laid out in randomized complete block design with five replications. The treatments were T1: Control (with no pinching and MH spray), T2: Pinching the growing tips at 30 DAS, T3: Maleic hydrazide (500 ppm) spray at 30 DAS and T4: Maleic hydrazide (1000 ppm) spray at 30 DAS. The apical flower buds of all the plants were removed acropetally at 30 days after sowing (DAS) without causing severe damage to the plant parts in each replication. Maleic hydrazide (MH) was sprayed at different concentration (500 and 1000 ppm) on 30th day after sowing (DAS) for the respective treatments. The growth and yield parameters viz., plant height (cm), number of branches per plant, days to 50 percent flowering, days to maturity, number of pods per plant, number of seeds per pod, pod yield per plant (g), pod yield per hectare (kg), seed yield per plant (g) and seed yield per hectare (kg) were recorded. Further, the seed quality parameters viz., seed moisture content, 100 seed weight (g), seed germination (%), seedling length (cm), seedling dry weight (mg), seedling vigour indices as per Abdul Baki and Anderson (1973), electrical conductivity (dSm⁻¹), accelerated ageing test response and field emergence (%) were also recorded from the resultant crop.

The moisture content of seeds (%) was determined by low constant temperature oven method as per ISTA rules (Anonymous, 2007). For 100 seed weight, from each treatment combination, sample of 100 seeds were randomly taken and the average weight of eight replicates was recorded and expressed in grams. The germination test was carried out in four replicates of hundred seeds in each treatment and tested seed germinator maintained at 25±1°C and 90±2 per cent RH using the ‘Between Paper’ method as per ISTA rules (Anonymous, 2007). The number of normal seedlings was counted on fourth and tenth day of germination test as first and final count, respectively and the average of four replications was worked out and expressed as percentage based on normal seedlings. Ten normal seedlings were selected at random from the germination test on tenth day (final count). The length from the collar region to the apex of the shoot was measured and mean was worked out and the shoot length was expressed in centimeters. The same ten normal seedlings used for measuring the shoot length (cm), were also used to measure the length between collar region and tip of the root and mean was calculated and expressed in centimeter as root length. Summation of mean shoot and root lengths was considered as mean seedling length (cm). The ten seedlings used for recording seedling length were kept in hot air oven at 70±1°C for 24h. The dry weight of seedling was recorded after keeping them half an hour in a desiccators for cooling and mean was expressed in milligrams. The seedling vigour indices were calculated as per the formula given by Abdul Baki and Anderson (1973). [SVI-I= Germination (%) x Mean seedling length (cm) and SVI-II = Germination (%) x Mean seedling dry weight (mg)]. Twenty five seeds of four replicates were washed with acetone for few minutes and soaked in 25 ml of double distilled water and kept in an incubator maintained at 25±1°C for 18hr. Then, the steeped water (seed leachate) from the soaked seeds was collected and electrical conductivity (EC) of the leachate was measured in desi simens per meter digital conductivity meter. The EC values due to electrolytes were expressed in dSm⁻¹ (Presley, 1958). The accelerated ageing (AA) test was performed according to the procedure outlined by Delouche and Baskin (1973). The required quantities of seeds were subjected to mild ageing by incubating them at 40±1°C and 80±2 per cent RH. Seeds were kept in a single layer on a perforated wire mesh in desiccators containing saturated solution of KNO₃ for six days in thermostatically controlled oven. After incubation, the samples were taken out and air dried until the original weight was obtained. Then the aged seeds were evaluated for germination (%) as per ISTA (Anonymous, 2007). Field emergence (%) was determined for two hundred seeds from each treatment were collected at random and sown in four replications of 50 seeds each on a well prepared raised seed bed and optimum soil moisture was maintained by watering regularly. The number of seedlings emerged on 15th day of sowing were counted and expressed in percentage taking into account the normal seedlings emerged out.

**RESULTS AND DISCUSSION**

The plant height (cm) at 60 DAS and at harvest due to pre-flowering pinching and maleic hydrazide spray differed significantly. The lower plant height was recorded with T₃ (36.42 cm). However, at harvest, control (T₀) plants produced significantly higher plant height (59.69 cm) and T₃ recorded lower plant height (48.06 cm), although, T₂ was on par with T₃. Also significant differences were observed for days to 50 per cent flowering and days to maturity among the different treatments. T₂ and T₃ took significantly more number of days to 50 per cent flowering (40.00 and 39.75) as compared to T₁, which took less number of days to 50 per cent flowering (34.75) and least number of days to maturity (88) compared to more number in T₁ (92.50 days) (Table 1).

Plants without apical pinching (T₀) recorded significantly higher plant height at 60 DAS (41.24cm) and at harvest (59.69cm) while, pinched plants (T₂) recorded significantly higher number of branches per plant at harvest.
Influence of pre-flowering pinching and maleic hydrazide spray on seed quality parameters of fenugreek cv. Pusa Early

Table 1: Influence of pre-flowering pinching and maleic hydrazide spray on growth and seed yield of fenugreek cv. Pusa Early Bunching

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Plant height at 60 DAS (cm)</th>
<th>Plant height at harvest (cm)</th>
<th>No. of branches at harvest per plant</th>
<th>Days to 50% flowering</th>
<th>Days to maturity</th>
<th>No. of pods per plant</th>
<th>Pod yield per plant (g)</th>
<th>Pod yield per ha (kg)</th>
<th>No. of seeds per pod</th>
<th>Seed yield per plant (g)</th>
<th>Seed yield per ha (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₁</td>
<td>41.24</td>
<td>59.69</td>
<td>10.34</td>
<td>39.75</td>
<td>92.5</td>
<td>38.8</td>
<td>23.28</td>
<td>2587</td>
<td>10.24</td>
<td>15.13</td>
<td>1681</td>
</tr>
<tr>
<td>T₂</td>
<td>38.65</td>
<td>50.09</td>
<td>13.8</td>
<td>34.5</td>
<td>88</td>
<td>45.02</td>
<td>27.92</td>
<td>3102</td>
<td>16.36</td>
<td>20.07</td>
<td>2230</td>
</tr>
<tr>
<td>T₃</td>
<td>36.42</td>
<td>48.06</td>
<td>13.88</td>
<td>40</td>
<td>91.5</td>
<td>46.65</td>
<td>28.93</td>
<td>3214</td>
<td>15.68</td>
<td>20.03</td>
<td>2225</td>
</tr>
<tr>
<td>T₄</td>
<td>37.01</td>
<td>49.47</td>
<td>12.52</td>
<td>39.3</td>
<td>90.5</td>
<td>46.4</td>
<td>28.42</td>
<td>3158</td>
<td>14.16</td>
<td>19.37</td>
<td>2152</td>
</tr>
<tr>
<td>Mean</td>
<td>38.33</td>
<td>51.73</td>
<td>12.64</td>
<td>39.13</td>
<td>90.63</td>
<td>44.22</td>
<td>27.14</td>
<td>3015</td>
<td>14.11</td>
<td>18.65</td>
<td>2072</td>
</tr>
<tr>
<td>S.E.Em±</td>
<td>0.18</td>
<td>0.35</td>
<td>0.12</td>
<td>0.23</td>
<td>0.25</td>
<td>0.17</td>
<td>0.12</td>
<td>12.9</td>
<td>0.12</td>
<td>0.08</td>
<td>932</td>
</tr>
<tr>
<td>CD (0.05P)</td>
<td>0.82</td>
<td>1.58</td>
<td>0.54</td>
<td>1.05</td>
<td>1.13</td>
<td>0.74</td>
<td>0.53</td>
<td>58.04</td>
<td>0.55</td>
<td>0.38</td>
<td>41.93</td>
</tr>
</tbody>
</table>

Pinched plants also took significantly less number of days to 50% flowering (34.50) and days to maturity (88.00) (Table 1). The increased plant height with T₁ was mainly because of non pinched plants retained the original plant height without causing reduction. However, number of branches per plant was more in case of pinched plants, since the pinching of apical buds resulted in production of more number of secondary branches. Besides, it also helped in altering the source to sink ratio and thus advancing the reproductive phase. Similar results were reported by Thakral et al. (1991) and Menon and Khader (1997) in coriander and Sudarshan (2004) in fenugreek.

Foliar spray with maleic hydrazide (T₃) was on par with pinched plants (T₂) for the growth parameters. This indicated that maleic hydrazide, a growth retardant, also had similar effects of pinching ‘apical bud’ of plants. Since, maleic hydrazide is an inhibitor, a reduction in stem length may be attributed to a reduction in cell division, cell enlargement, osmotic solute concentration in the cell, permeability of water, cell wall pressure and other synthesis activities (Singh and Sarkar, 1976) causing retardance. Besides, maleic hydrazide arrests the apical dominance and induces lateral buds to grow. Alagukannan and Vijaykumar (1999a) and Alagukannan and Vijaykumar (1999b) also opined the similar results and therefore, the maleic hydrazide could be used as an alternative to manual apical pinching to alter the plant growth in fenugreek.

In any crop, yield is a function of plant growth, number of reproductive branches and better source-sink relationship. Arresting of vertical growth of plants by pinching terminal bud at certain stage always results in induction of more number of productive branches. In general, pinched plants recorded significantly higher values for all the yield parameters over non-pinched plants. The number of pods per plant, pod weight per plant and pod weight per hectare were higher in T₃ (maleic hydrazide @ 500ppm) (46.65, 28.93g and 3214kg) which were closely followed by pinched plants (T₄) lower in T₁ (38.80, 23.28 g and 2587 kg), respectively (Table 1). However, the number of seeds per pod, seed weight per plant and seed weight per hectare was significantly higher in T₂ over T₁ and T₃ (16.36, 20.07g and 2230kg). The increase in seed yield and yield parameters of pinched plants was mainly because of production of more side shoots / branches which ultimately resulted in higher number of pods per plant, seeds per pod and thus seed yield. These results were in conformity with the findings of Thakral et al. (1991), Baboo and Rana (1995) in coriander, Venkatareddy et al. (1997), Sajjan et al. (2002) in okra and Gill et al. (2001) in fenugreek. Increase in seed yield by maleic hydrazide spray has also been reported by Alagukannan and Vijaykumar (1999b) in fenugreek and Renuga et al. (2000) in coriander.

Seed moisture content did not differ significantly due to pre-flowering pinching and MH spray. There was a

Table 2: Influence of pre-flowering pinching and maleic hydrazide spray on seed quality parameters of fenugreek cv. Pusa Early Bunching

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Moisture content (%)</th>
<th>100 seed weight (g)</th>
<th>Germination (%)</th>
<th>Seedling length (cm)</th>
<th>Seedling dry weight (mg)</th>
<th>Seedling vigour index-I</th>
<th>Seedling vigour index-II</th>
<th>Electrical conductivity (dSm⁻¹)</th>
<th>Germination (%) after AA test</th>
<th>Field emergence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₁</td>
<td>9.88</td>
<td>1.328</td>
<td>90.00</td>
<td>19.60</td>
<td>11.56</td>
<td>1764</td>
<td>1040</td>
<td>148</td>
<td>77.00</td>
<td>79.00</td>
</tr>
<tr>
<td>T₂</td>
<td>9.66</td>
<td>1.667</td>
<td>95.40</td>
<td>23.80</td>
<td>16.60</td>
<td>2271</td>
<td>1584</td>
<td>126</td>
<td>84.80</td>
<td>87.20</td>
</tr>
<tr>
<td>T₃</td>
<td>9.64</td>
<td>1.562</td>
<td>94.40</td>
<td>23.31</td>
<td>14.88</td>
<td>2240</td>
<td>1405</td>
<td>132</td>
<td>83.20</td>
<td>85.20</td>
</tr>
<tr>
<td>T₄</td>
<td>9.44</td>
<td>1.484</td>
<td>94.60</td>
<td>21.33</td>
<td>14.28</td>
<td>2017</td>
<td>1351</td>
<td>138</td>
<td>82.80</td>
<td>83.60</td>
</tr>
<tr>
<td>Mean</td>
<td>9.66</td>
<td>1.510</td>
<td>93.60</td>
<td>22.01</td>
<td>14.33</td>
<td>2063</td>
<td>1345</td>
<td>136</td>
<td>81.95</td>
<td>83.75</td>
</tr>
<tr>
<td>S.E.Em±</td>
<td>0.14</td>
<td>0.01</td>
<td>0.36</td>
<td>0.17</td>
<td>0.13</td>
<td>14.79</td>
<td>13.25</td>
<td>1.09</td>
<td>0.54</td>
<td>0.50</td>
</tr>
<tr>
<td>CD (0.05P)</td>
<td>NS</td>
<td>0.60</td>
<td>1.62</td>
<td>0.75</td>
<td>0.58</td>
<td>66.58</td>
<td>59.65</td>
<td>4.90</td>
<td>2.41</td>
<td>2.23</td>
</tr>
</tbody>
</table>

T₁ - control (with no pinching and MH spray); T₂ - pinching the growing tips at 30 DAS; T₃ - MH spray at 30 DAS @ 500 ppm and T₄ - MH spray at 30 DAS @ 1000 ppm
significant variation among the treatments for all other seed quality parameters (Table 2). Apically pinched plants (T₃) recorded higher test weight (1.667 g), germination (95.40%), seedling length (23.80 cm), seedling dry weight (16.60 mg), SVI-I (2271), SVI-II (1584), germination upon accelerated aging (84.80%) and field emergence (87.20%) and it was lower in T₁ (1.328 g, 90.00%, 19.60 cm, 11.56 mg, 1764, 1040, 77.00% and 79.00%), respectively. Lower EC (126 dSm⁻¹) was recorded in T₂ whereas, no pinching and MH spray recorded higher EC (148 dSm⁻¹).

Seed quality attributes were significantly higher in pinched plants suggesting that pinching of apical bud greatly influenced the seed quality. Further, plants with foliar application of maleic hydrazide (500ppm) also exhibited on par results with pinched plants. On the contrary, plants sprayed with maleic hydrazide (1000ppm) recorded lesser values for these quality parameters which might have caused detrimental effect on growth due to higher dose of this growth retardant (MH). The better performance of pinched plants was because of more number of branches, increase in photosynthetic area leading to higher photosynthetic rate, accumulation of more photosynthates resulting into better seed development which ultimately caused better seed germination and seedling vigour index. Similar increase in germination and decrease in electrical conductivity of seed leachate with apical bud pinching at 40 DAS were noticed by Phor and Mangal (1991) in palak and Sajjan et al. (2002) in okra while, increased vigour index with apical pinching was also reported by Venkata Reddy et al. (1997) in okra. Further, increased test weight with removal of herb was reported by Mehta et al. (1995) and Gill et al. (2001) in fenugreek. Kanaujia et al. (2002) also observed similar effects with the application of TIBA in onion.

Therefore, it is clearly evident from the study that pinching of apical bud at early stages had profound influence on growth, productivity and seed quality as it provided sufficient time for regeneration of vegetative growth and for enhancement of more number of reproductive branches. Even though the apical pinching would be a beneficial practice, but it is difficult to perform on a commercial scale and found not economical. Further, spraying of maleic hydrazide (500ppm) had similar effect on growth, seed yield and quality parameters. Therefore, on commercial scale, 500 ppm of maleic hydrazide can be effectively used to obtain higher seed yield with better quality on par with manual pinched plants and that could be used as an alternative to pinching or topping.

REFERENCES


