Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(3): 3206-3208
Received: 16-03-2019
Accepted: 18-04-2019

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Influence of nipping and spacing on growth and yield of rainfed horsegram (*Macrotyloma uniflorum*)

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Abstract
A field trial was conducted at Tamil Nadu Agricultural University, Coimbatore to investigate the influence of nipping and spacing on the growth and yield of rainfed horsegram. The experiment consisted of 18 treatment combinations with two factors studied under factorial randomized block design with two replications. The factor one with three levels of crop geometry (C_1: Broadcasting, C_2: 30 X 10 cm, C_3: 30 X 20 cm) and second factor with six levels of nipping (N_1: manual nipping, N_2: mepiquat chloride 125 ppm, N_3: mepiquat chloride 250 ppm, N_4: chlormequat chloride 125 ppm, N_5: chlormequat chloride 250 ppm, N_6: no nipping). Nipping and growth retardants spray was done at 55 DAS, Growth and yield parameters such as plant height, number of branches, number of pods plant^{-1}, number of seeds pod^{-1}, test weight and harvest index were recorded. Spacing of 30 X 10 cm recorded significantly higher yield (803 kg ha^{-1}), whereas more number of branches (7.2), higher number of pods plant^{-1} (46.94) were recorded with a spacing of 30 X 20 cm. Spraying of mepiquat chloride 250 ppm recorded significantly higher yield (872 kg ha^{-1}), more number of branches (8.1), higher number of pods plant^{-1} (54.85) and higher harvest index (0.233) followed by spraying of chlormequat chloride 250 ppm spray with a yield of 809 kg ha^{-1}. Among the treatment combinations, spacing of 30 X 10 cm with mepiquat chloride spray recorded the higher yield (946 kg ha^{-1}).

Keywords: Horsegram, nipping, spacing, mepiquat chloride, chlormequat chloride

Introduction
Horsegram (*Macrotyloma uniflorum*) is an underutilized food legume (Marimuthu., 2013) [1], well popularized for its hardiness and wider adaptability to adverse climatic conditions and poor soils which are unsuitable for other crops (Suthar *et al.*, 2017) [2]. Horsegram is an important cover crop and it can fix atmospheric nitrogen through root nodules. Tamil Nadu and Andhra Pradesh together account for nearly 90% of the total Indian acreage under horsegram crop (Fuller *et al.*, 2017) [3].

In India, horsegram covers an area of 3.25 lakh hectares with a production of 1.16 lakh tonnes during 2016-17 (WWW.Indiastat.com) [4]. whereas in Tamil Nadu it covers an area of 0.75 lakh hectares with a production of 0.44 lakh tonneswith a productivity of 588 kg ha^{-1}during 2015-16 (Season and crop report, 2015-16) [5]. The yield of horsegram can be modified by various management practices such as nipping and crop geometry.

Crop geometry plays a significant role on the growth and development of crop as wider spacing reduces the competition between the plants (Kithanand Singh., 2017) [6].

Nipping is a practice of removal of the apical bud that promotes the lateral growth. Once the apical dominancehas been lifted from the plant, lateral growth is promoted and lateral branches will be produced by the activation of lateral buds (Patel *et al.*, 2016) [7]. Dhital *et al.*, (2017) [8] stated that nipping before or at 30 DAS significantly enhanced the productivity in pea as it plays an important role in nodulation.

Materials and methods
A field trial was conducted during *rabi* season of 2018 at eastern block farm of department of Agronomy at Tamil Nadu agricultural University, Coimbatore which is situated at a latitude of 11.01^0, longitude of 76.93^0 and 426 meters above the mean sea level (MSL). The experiment consisted of eighteen treatment combinations comprising of three crop geometries (C_1: Broadcasting, C_2: 30 X 10 cm, C_3: 30 X 20 cm) and six levels of nipping (N_1: manual nipping, N_2: mepiquat chloride 125 ppm, N_3: mepiquat chloride 250 ppm, N_4: chlormequat chloride 125 ppm, N_5: chlormequat chloride 250 ppm, N_6: no nipping. Nipping and growth retardants spray was done at 55 DAS. The experiment was laid out in Factorial Randomized block design with two replications. Nitrogen (12.5 kg ha^{-1}), Phosphorous (25 kg ha^{-1}) and potassium (12.5 kg ha^{-1})

was applied as basal. Pulse wonder was sprayed at 65 DAS at the rate of 2kg ha^{-1}.During the crop season, one supplemental irrigation was given at the time of flowering and intercultural operations were done at 25 DAS to remove the weeds. The crop matured at 115 days and harvested in the last week of February. After harvesting, the data on yield attributing characters such as number of pods $plant^{-1}$, seeds pod^{-1}, 100 seed weight, seed yield, haulm yield and harvest index were statistically analysed and critical differences were calculated.

Results and Discussions

Plant height

Data related to the plant height are tabulated in table 1. Which showed that the maximum height was observed with a treatment combination of no nipping + 30 X 20 cm spacing with a plant height of 74.72 cm at harvest. As the apical bud is nipped by the nipping process, the photosynthates are utilized for the production of the lateral branches and because of this reason there might be a reduction in the height of nipped plants which were also reported by Kithan and Singh (2017) [6]. Among the plant geometries, though the maximum height was observed with a spacing of 30 X 20 cm (62.86 cm) compared to 30 X 10 cm (60.97 cm), there was no significant difference between those spacings with respect to height. This might be because of the competition between the plants for sunlight, nutrients and space that leads to self thinning of the plants at narrow spacing and the vertical growth can be increased in wider spacing and are in conformity with the findings of Kumar *et al*., (2017) [9].

Number of branches $plant^{-1}$

As shown in table 1, Results indicated that the number of branches per plant significantly affected by different spacings at 90 DAS and at harvest where as it was unaffected at 60 DAS. Number of branches were more in case of the treatment combination of mepiquat chloride 125 ppm + 30 X 20 spacing (8.4). The reason for increased number of branches might be because of the fact that the application of mepiquat chloride acts more or less as an anti-auxin. As auxin is responsible for the apical dominance, more number of branches will be produced as the apical dominance is removed which was explained by Prashant (2005) [10]. The maximum number of branches were observed at a spacing of 30 X 20 cm (7.2) significantly more than that of 30 X 10 cm spacing (6.7). As the spacing is wider in case of 30 X 20 cm, the competition for individual plant is less which leads to more number of branches. Similar results were obtained with Kumar *et al*., (2017) [9].

Yield attributes

As mentioned in the Table 1, In case of nipping, higher pods $plant^{-1}$(54.85), seed pod^{-1}(6.267), 100 seed weight (3.687), seed yield (872 kg ha^{-1}), haulm yield (2963 kg ha^{-1}) and harvest index (0.233) were found to be higher for the foliar spray of mepiquat chloride 250 ppm. Increased number of lateral branches leads to an increased number of pods $plant^{-1}$ that ultimately leads to an increased yield and yield attributes which is in accordance with Jaidka *et al.,* (2018) [11] and Khan *et al*., (2018) [12].

Whereas among the treatment combinations, theseed yield (946 kg ha^{-1}), haulm yield (3049 kg ha^{-1}) and harvest index (0.237) was found to be highest for the treatment combination of mepiquat chloride 250 ppm and 30 X 10 cm. Though the higher pods $plant^{-1}$(46.94), seed pod^{-1}(6.145), 100 seed weight (3.657 g) were obtained with a spacing of 30 X 20 cm, because of the higher plant population in 30 X 10 cm compared to 30 X 20 cm, the yield was more with a spacing of 30 X 10 cm. The higher yield attributes under wide crop geometry is due better absorption of moisture and nutrients by the individual crop which is supported by Kumar *et al*., (2017) [9].

Seed yield

Data related to seed yield is tabulated in table 2. Among the treatment combinations, mepiquat chloride 250 ppm + 30 X 10 cm recorded the maximum yield of 946 kg/ha. 32.9% increase in yield was observed in nipping over no nipping. Khan *et al*., 2018 [12] reported that the increased yield is due to more number of lateral branches which produces more pods. Spraying of mepiquat chloride results in increased photosynthetic rate and efficient translocation of photosynthates to reproductive parts that results in higher number of pods and seed yield which are in line with Jaidka *et al.,* (2018) [11].

Conclusion

From the above study, it could be concluded that spraying mepiquat chloride 250 ppm. and spacing of 30 X 10 cm is recommended for better yield in horsegram

Table 1: Effect of nipping and crop geometry on growth and yield parameters

Treatment	Grain yield (kg ha^{-1})	Haulm yield (kg ha^{-1})	Harvest index
Crop geometry (C)			
C_1 - Broadcasting	729	2328	0.215
C_2 - Line sowing at 30 X 10 cm	803	2577	0.226
C_3 - Line sowing at 30 X 20 cm	677	2419	0.220
SEd	20.33	70.44	0.005
CD (p=0.05)	42.91	148.63	0.012
Nipping (N)			
N_1 - Manual nipping	714	2540	0.219
N_2 - Mepiquat chloride 125 ppm	785	2724	0.224
N_3 - Mepiquat chloride 250 ppm	872	2963	0.233
N_4 - Chlormequat chloride 125 ppm	643	2253	0.222
N_5 - Chlormequat chloride 250 ppm	809	2742	0.230
N_6 - No nipping	566	2225	0.203
SEd	28.76	99.62	0.008
CD (p=0.05)	60.68	210.19	0.017
Interaction			
SEd	49.81	172.55	0.014
CD (p=0.05)	105.11	364.07	0.030

Table 2: Effect of nipping, crop geometry on yield of horsegram

Treatment	Plant height (cm)	Number of branches plant^{-1}	Pods plant^{-1}	Seeds pod^{-1}	100 seed weight
Crop geometry (C)					
C_1 - Broadcasting	56.03	6.1	39.48	5.841	3.322
C_2 - Line sowing at 30 X 10 cm	60.97	6.7	44.32	5.937	3.517
C_3 - Line sowing at 30 X 20 cm	62.86	7.2	46.94	6.145	3.657
SEd	1.72	0.19	1.22	0.160	0.092
CD (p=0.05)	3.63	0.41	2.59	0.338	0.195
Nipping (N)					
N_1 - Manual nipping	61.08	6.3	41.68	5.876	3.450
N_2 - Mepiquat chloride 125 ppm	56.04	7.0	47.03	5.989	3.506
N_3 - Mepiquat chloride 250 ppm	48.96	8.1	54.85	6.267	3.687
N_4 - Chlormequat chloride 125 ppm	66.39	5.8	37.32	5.776	3.418
N_5 - Chlormequat chloride 250 ppm	55.01	7.4	47.86	6.212	3.566
N_6 - No nipping	71.80	5.5	32.72	5.727	3.363
SEd	2.43	0.27	1.73	0.227	0.131
CD (p=0.05)	5.14	0.58	3.66	0.479	0.276
Interaction					
SEd	4.22	0.47	3.00	0.393	0.227
CD (p=0.05)	8.91	0.99	6.34	0.830	0.479

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