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Response of horsegram (*Macrotyloma uniflorum*) to spacing and nipping

T Gangadhara, PH Patel, Akshay Kumar Kurdekar and Yonika Saini

Abstract
A field experiment on "Response of horsegram (*Macrotyloma uniflorum*) to spacing and nipping" was carried out during *kharif* 2020 at Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar in loamy sand. It comprised two spacings (30 cm × 10 cm and 45 cm × 10 cm) and six nippings [no nipping, manual nipping, foliar spray each of cycocel (60 & 80 ppm) and mepiquat chloride (125 & 250 ppm)] at 55 DAS with randomized block design (factorial) replicated thrice. The spacing of 45 cm × 10 cm recorded significantly higher number of branches, leaf area, pod weight/plant reduced number of days to initiation and 50% flowering. Under nipping, spraying of mepiquat chloride @ 250 ppm recorded significantly higher number of branches/plant, leaf area/plant, dry matter/plant, number of pods/plant, pod weight/plant, seed yield (870 kg/ha) and haulm yield (3,119 kg/ha) . Among interactions, spacing of 45 cm × 10 cm coupled with mepiquat chloride spray @ 250 ppm recorded the maximum leaf area, dry matter/plant at harvest, number of pods/plant and seed yield (968 kg/ha) . In terms of seed yield increment, it was found that there was 47.2% increase by mepiquat chloride spray @ 250 ppm as compared to no nipping. In case of economic returns, the highest net returns (₹23,341/ha) and BCR (2.16) were obtained under spacing of 30 cm × 10 cm coupled with mepiquat chloride spray @ 250 ppm which was ultimately found suitable for horsegram.

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

Introduction
Globally, pulses are the second most important group of crops after cereals and have been traditionally recognized as an indispensable constituent of Indian diet. Pulses have done to the people of this country is by their ideally supplementing the cereal rich diet predominantly vegetarian masses by virtue of their being rich in protein and several amino acids. At present, in India, total area under pulses is 29.81 million hectares with production of 25.41 million tons with a extremely low average productivity of 853 kg/ha during 2017-18 (Indiaagristat, 2018a) [1]. There is an enormous yield gap between India and alternative developed countries and within India, between research station's yield and farmer's yields. Horsegram (*Macrotyloma uniflorum)* is the fifth most generally grown pulse species in trendy India. In India, it is typically grown in Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, Maharashtra, West Bengal, Bihar, Orissa, rainfed areas of Uttar Pradesh as well as the tribal belts of Rajasthan and Gujarat. In India, horsegram covers an area of 0.4 million ha with production 0.247 million tonnes and productivity 618 kg/ha during 2017-18 (Indiaagristat, 2018b) [2]. In recent years, scientists have given attention to the concept of agronomic practices like optimum plant population through proper spacing and regulation of the plant growth to extend the production by suppressing apical dominance through apical nipping and use of plant growth retardants for realizing yield potential. Spacing plays a crucial role in maintaining adequate plant population. Institution of appropriate spacing for maintaining the optimum plant population per unit area is indispensable to obtain maximum yield for any field crop. Nipping is an important practice that removes the apical dominance and promotes the lateral branches that successfully improves the yield of crops. It plays an important role for better maintenance of source and sink relationship and for ameliorating the productivity. Nipping can be practiced in two ways either by clipping manually or by spraying growth retardants like mepiquat chloride, chlormequat chloride and maleic hydrazide (Sanbagavalli *et al.*, 2020) [3]. Kumar *et al.* (2018[b]) [4] stated that nipping of plants at 55 DAS decreased plant height but enhanced the number of branches, dry matter and seed yield of field bean.

Materials and Methods

A field experiment was carried out during the *kharif* season of 2020 at Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat which is situated geographically at 24^0 – 19' North latitude and 72 ^{0} – 10' East longitude with an altitude of 154.52 meter above the mean sea level (MSL) which represents the North Gujarat Agro-climatic Zone. The soil of the experimental plot was loamy sand in texture, low in organic carbon and available nitrogen, medium in available phosphorus and high in available potash having alkaline reaction. The sowing of horsegram cultivar **'**Gujarat Dantiwada Horsegram 1' treated with *Rhizobium leguminoserum* and PSB culture @ 5ml/kg of seed was done on 8th July, 2020 keeping the inter-row spacing as per treatments and intra-row spacing of 10 cm using seed rate of 12 kg/ha for 30 cm row spacings and 8 kg/ha for 45 cm row spacings in well prepared seed plots of 5 m × 3.6 m gross plots and 4 m × 2.7 m net plots, respectively. The experiment comprised of two spacings (30 cm × 10 cm and 45 cm × 10 cm) and six nippings [no nipping, manual nipping, foliar spray each of cycocel (60 & 80 ppm) and mepiquat chloride (125 & 250 ppm)] at 55 DAS with randomized block design (factorial) replicated thrice. The recommended dose of fertilizers were applied as basal dose at the time of sowing @ 20 kg N/ ha and 40 kg P_2O_5/ ha through urea and diammonium phosphate. The total rainfall received during the crop growth period was 1273.5 mm which was optimum for better growth and yield. Various field observations like plant population, plant height (cm) , number of branches per plant, days to flower initiation, days to 50 percent flowering, dry matter at harvest (g/plant) , number of pods per plant, pod weight per plant (g) , seed yield per hectare, haulm yield per hectare were recorded. The data collected for various parameters during the course of investigation were statistically analysed using computer by an appropriate design as described by Panse and Sukhatme (1967) [5]. The significance of difference was tested by 'F' test at 5 per cent level. The critical differences were calculated when the differences among treatments were found significant under 'F' test. If the F test is non-significant it was indicated by the letters NS.

Results and Discussion

Effect on plant population

Data on plant population recorded at 25 DAS and at harvest presented in Table 1 revealed that significantly higher plant population at 25 DAS (2,86,469 /ha) and at harvest (2,63,771/ha) was recorded with spacing of 30 cm × 10 cm. No significant difference in plant population was observed due to various nipping treatments and interaction effect between spacing and nipping.

Effect on Growth Attributes

Plant height (cm)

The data recorded at 25 DAS and at harvest regarding plant height is presented in Table 1. The plant height did not differ significantly due to different spacing treatments at 25 DAS and at harvest. Nipping treatments did not show any significant difference in plant height at 25 DAS. At harvest, significantly superior plant height was observed by no nipping (66.6 cm) and the reason for superior plant height might be due to undisturbed and continue top growth of horsegram in no nipping treatment which assisted the crop to attain maximum height. These results are also in agreement with Sujatha *et al*. (2017) [6] in chickpea, Jaidka *et al.* (2018) [7] in soybean, Kumar *et al*. (2018^b) [4] in fieldbean and Pious and Reddy (2018) [8] in sunflower. However, interaction effect between spacing and nipping was found non-significant with respect to plant height at 25 DAS and at harvest.

Number of branches

The data on number of branches per plant is presented in Table 1. Significantly maximum number of branches (12.3) was observed with spacing 45 cm × 10 cm. Significant effect on enhancing number of branches per plant of horsegram with different levels of spacing may be attributed due to availability of better moisture, sunlight, nutrients and more space under wider spacing as compared to narrow spacing. Similar results were reported by Kalsaria *et al.* (2017) [9] in greengram, Sasmitha *et al.* (2017) [10] in clusterbean, Khan *et al.* (2017) [11] in mungbean and Gurjar *et al.* (2018) [12] in greengram. Significantly maximum number of branches per plant was recorded under the treatment of mepiquat chloride spray @ 250 ppm (12.8) and it was at par with CCC (Cycocel) spray @ 80 ppm (12.2) and mepiquat chloride spray @ 125ppm (11.8) and minimum number of branches per plant was observed in the treatment having no nipping (10.4). The reason for significant increase in number of branches per plant of horsegram might be due to inhibition in the auxin activity in the plant due to the application of cycocel and mepiquat chloride which acts more or less as an anti-auxin. As the auxin is behind the apical dominance, more number of branches will be produced as the apical dominance is removed which was explained by Reddy (2009) [13]. Similar results were also recorded by Singh *et al*. (2014) [14] in kabuli gram, Sujatha *et al*. (2017) [6] in chickpea, Paikra *et al*. (2018) [15] in soybean and Solanke *et al*. (2018) [16] in soybean. However, interaction effect between spacing and nipping was found non-significant with respect to number of branches.

Days to initiation of flowering

The data regarding days to flower initiation of horsegram is presented in the Table 1. The differences in days to initiation of flowering reduced with increase in spacing between rows and varied significantly. Days to initiation of flowering found minimum (39.9) with 45 cm × 10 cm spacing. The significant decrease in days to initiation of flowering was seen as spacing between rows increased. The reason may be due to wider spacing, more space, sunlight, and nutrients were available for plants and hence early flowering was seen as compared to narrow spacing. No significant difference in days to flower initiation was observed due to various nipping treatments and interaction effect between spacing and nipping.

Days to 50% flowering

The data pertaining to the effect of various levels of spacing and nipping treatments on days to 50% flowering of horsegram is presented in the Table 1. Increase in spacing between rows reduced the days to 50% flowering and varied significantly. Spacing of 45 cm × 10 cm found minimum (46.7) number of days to 50% flowering. Significant decrease in number of days to 50% of flowering was seen as spacing between rows increased. The reason may be due to wider spacing, more space, sunlight, and nutrients were available for plants and hence early flowering was seen as compared to narrow spacing. No significant difference in days to flower initiation was observed due to various nipping treatments and interaction effect between spacing and nipping.

Leaf area (cm^2) /plant

The data related to effect of various levels of spacing and nipping treatments on leaf area of horsegram is presented in Table 1 & 2. The leaf area of horsegram was significantly affected by the various levels of spacing. Maximum leaf area (1045.4 cm^2) was produced by the spacing of 45 cm × 10 cm which was significantly superior over 30 cm × 10 cm spacing. Significant positive effect on leaf area of horsegram with different levels of spacing might be due to availability of larger area for better crop growth and supply of plant nutrients in adequate quantities. Similar results have been reported by Sasmita *et al.* (2017) in clusterbean and Kumar *et al.* (2018[a]) in chickpea. The leaf area of horsegram significantly affected by various levels of nipping treatments. Maximum leaf area (1332.5 cm^2) was produced by the foliar spray of mepiquat chloride @ 250 ppm which was significantly superior over no nipping. The total leaf area of plants is a product of number of branches, number of leaves per branch and individual leaf area. The reason for increase in leaf area might be due to foliar spray of mepiquat chloride which increased the number of branches and leaves which resulted to enhanced leaf area. The leaf area of horsegram was significantly affected by the interaction effect of different spacing and nipping treatments. Significantly maximum leaf area (1388.9cm^2) was recorded with a spacing 45 cm × 10 cm coupled with mepiquat chloride spray @ 125 ppm which was at par with 30 cm × 10 cm spacing coupled with mepiquat chloride spray @ 250 ppm (1355.7cm^2) and 45 cm × 10 cm spacing coupled with mepiquat chloride spray @ 250 ppm (1309.4cm^2).

Dry matter at harvest (g/plant)

Data on dry matter at harvest of horsegram under different spacing and nipping treatments is presented in Table 1 & 3. The crop sown with different spacing had no significant effect on dry matter at harvest. Dry matter at harvest was significantly influenced due to different nipping treatments. Significantly maximum dry matter at harvest was recorded under the treatment of mepiquat chloride spray @ 250 ppm (34.4g) which was at par with mepiquat chloride spray @ 125 ppm (32.6g). The increased dry matter accumulation at harvest was mainly due to higher leaf biomass and more number of branches per plant which might have contributed for increased dry matter accumulation per plant. Similar results were also observed by Jaidka *et al.* (2018) [7] in soybean, Patil (2019) [18] in soybean and Singh *et al.* (2019) [19] in greengram. The interaction effect of different spacing and nipping treatments significantly affected on the dry matter at harvest of horsegram. Significantly maximum dry matter at harvest was recorded with a spacing 45 cm × 10 cm paired with mepiquat chloride spray @ 250 ppm (35.6 g) and at par with 45 cm × 10 cm spacing paired with mepiquat chloride spray @ 125 ppm and 30 cm × 10 cm spacing paired with mepiquat chloride spray @ 250 ppm (33.2 g) and 45 cm × 10 cm spacing paired with CCC (Cycocel) spray @ 80 ppm (32.8 g).

Table 1: Plant population per hectare and growth attributes of horsegram as influenced by spacing and nipping

Treatment	Plant population		Plant height (cm)		Number of branches	Days to flower initiation	Days to 50% flowering	Leaf area/ plant (cm^2)	Dry matter/plant at harvest (g/plant)
	25 DAS	At harvest	25 DAS	At harvest					
Spacing (S)									
S_1: 30 cm × 10 cm	286469	263771	13.5	60.0	11.1	42.8	50.1	879.4	28.3
S_2: 45 cm × 10 cm	186145	184895	13.9	57.6	12.3	39.9	46.7	1045.4	29.6
S. Em. ±	3063	3484	0.25	1.01	0.26	0.54	0.61	22.29	0.55
C.D. at 5%	8985	10219	NS	NS	0.78	1.6	1.8	65.4	NS
Nipping (N)									
N_1: No nipping	236285	224284	14.1	66.6	10.4	41.4	48.6	757.9	24.7
N_2: Manual nipping	236326	224375	13.4	61.1	11.5	41.5	48.3	907.1	25.1
N_3: CCC (Cycocel) spray @ 60 ppm	236352	224420	13.5	58.2	11.4	41.6	48.9	1058.1	26.3
N_4: CCC (Cycocel) spray @ 80 ppm	236319	224356	13.6	57.9	12.2	41.3	48.2	766.8	30.4
N_5: Mepiquat Chloride spray @ 125ppm	236221	224195	13.4	56.2	11.8	41.3	48.9	951.9	32.6
N_6: Mepiquat Chloride spray @ 250ppm	236339	224367	14.1	53.0	12.8	41.1	47.7	1332.5	34.4
S. Em. ±	5306	6035	0.44	1.75	0.46	0.93	1.05	38.61	0.96
C.D. at 5%	NS	NS	NS	5.14	1.35	NS	NS	113.2	2.81
Interaction (S × N)									
S. Em. ±	7504	8535	0.62	2.48	0.65	1.31	1.48	54.60	1.35
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	160.1	3.97
C.V. %	5.50	6.59	7.8	7.3	9.6	5.5	5.3	9.8	8.1

Table 2: Interaction effect of spacing and nipping on leaf area (cm^2) of horsegram

	Nipping (N)					
Spacing (S)	**N_1: (No nipping)**	**N_2: (Manual nipping)**	**N_3: (CCC (Cycocel) spray @ 60 ppm)**	**N_4: (CCC (Cycocel) spray @ 80 ppm)**	**N_5: (Mepiquat Chloride spray @ 125ppm)**	**N_6: (Mepiquat Chloride spray @ 250ppm)**
S_1: 30 cm × 10 cm	867.4	705.7	1000.3	832.2	515.0	1355.7
S_2: 45 cm × 10 cm	648.6	1108.4	1116.0	701.3	1388.9	1309.4
S. Em. ±	54.60					
C.D. at 5%	160.1					
C.V. %	9.8					

Table 3: Interaction effect of spacing and nipping on dry matter (g/plant) at harvest of horsegram

	Nipping (N)					
Spacing (S)	**N_1: (No nipping)**	**N_2: (Manual nipping)**	**N_3: (CCC (Cycocel) spray @ 60 ppm)**	**N_4: (CCC (Cycocel) spray @ 80 ppm)**	**N_5: (Mepiquat Chloride spray @ 125ppm)**	**N_6: (Mepiquat Chloride spray @ 250ppm)**
S_1: 30 cm × 10 cm	25.3	25.9	27.9	27.9	29.7	33.2
S_2: 45 cm × 10 cm	24.2	24.4	24.7	32.8	35.6	35.6
S. Em. ±	1.35					
C.D. at 5%	3.97					
C.V. %	8.1					

Effect on Yield Attributes

Number of pods per plant

The data pertaining to effect of various levels of spacing and nipping treatments on number of pods per plant of horsegram is presented in Table 4 & 5. The differences in number of pods per plant were non-significant due to different level of spacing. Different nipping treatments had significant effect with respect to number of pods per plant. Among different nipping treatments, mepiquat chloride spray @ 250 ppm recorded significantly higher number of pods per plant (37.4) and it is at par with mepiquat chloride spray @ 125 ppm (34.6) as compared to other treatments. The increased number of pods per plant by application of mepiquat chloride was due to more number of lateral branches per plant which led to enhanced number of pods per plant. Similar results were obtained by Shyam (2016) [20] in summer greengram, Jaidka *et al.* (2018) [7] in soybean and Bhavana *et al.* (2019) [21] in horsegram. The interaction effect between different spacing and nipping treatments was found significant with respect to number of pods per plant. Significantly maximum number of pods per plant was recorded with a spacing 45 cm × 10 cm coupled with mepiquat chloride spray @ 250 ppm (43.4) and it was at par with 45 cm × 10 cm spacing coupled with mepiquat chloride spray @ 125 ppm (38.4).

Pod weight per plant (g/plant)

The data regarding pod weight per plant of horsegram under different spacing and nipping treatments is presented in the Table 4. Pod weight per plant was significantly influenced due to different spacing. Among the spacings, 45 cm × 10 cm spacing observed significantly maximum pod weight per plant (12.9 g). Significantly favorable effect of different levels of spacing with respect to pod weight per plant of horsegram may be attributed to wider availability of spacing, more availability of light and moisture and more nutrients available per plant which made plant to grow vigorously which resulted more number of branches and pods resulting into more pod weight as compared to narrow spacing. Pod weight per plant was significantly influenced due to different nipping treatments. Significantly maximum pod weight per plant was recorded under the treatment of mepiquat chloride spray @ 250 ppm (14.7) and it was at par with mepiquat chloride spray @ 125 ppm (13.6 g). The increase in pod weight per plant was attributed to application of mepiquat chloride which resulted into more number of lateral productive branches and pods resulting into more pod weight. Similar results were obtained by Patil (2019) [18] in soybean. Interaction effect between different spacing and nipping treatment was found non-significant with respect to pod weight per plant.

Seed yield (kg/ha)

The data pertaining to effect of various levels of spacing and nipping treatments on seed yield of horsegram is presented in Table 4 & 6. The seed yield was not influenced significantly due to different spacing. The seed yield was significantly influenced due to different nipping treatments. Significantly better seed yield (870 kg/ha) was recorded under the treatment of mepiquat chloride spray @ 250 ppm. The increase in seed yield was to the tune of 47.21 and 37.22 per cent over treatment no nipping and manual nipping, respectively. Significant difference in seed yield of horsegram with spraying of mepiquat chloride might be due to increase in photosynthetic rate and efficient translocation of photosynthates to reproductive parts which resulted in to higher number of pods and seed yield. These results are in accordance with the results obtained by Jaidka *et al.* (2018) [7], Pious and Reddy (2018) [8] in sunflower, Paikara *et al.* (2018) [15] in soybean and Sudharani and Sudhakar (2018) [22] in pigeonpea. Interaction effect between different spacing and nipping treatment was found significant with respect to seed yield. Significantly better seed yield was recorded with a spacing of 30 cm × 10 cm coupled with mepiquat chloride spray @ 250 ppm (968 kg/ha).

Haulm yield (kg/ha)

The data regarding haulm yield of horsegram under different spacing and nipping treatments is presented in the Table 4. The different levels of spacing had no significant influence on haulm yield of horsegram. The different nipping treatments had significant effect with respect to haulm yield of horsegram. Among different nipping treatments, mepiquat chloride spray @ 250 ppm recorded significantly higher haulm yield (3119 kg/ha) and it was at par with mepiquat chloride spray @ 125 ppm (2707 kg/ha). The increase in haulm yield was to the tune of 42.36 and 29.37 per cent over treatment no nipping and manual nipping, respectively.

Significant difference in haulm yield of horsegram with spraying of mepiquat chloride might be due to more number of lateral branches per plant and higher dry matter production at harvest. The similar results were reported in soybean by Paikara *et al.* (2018) [15] and Bhavana *et al.* (2019) [21] in horsegram. Interaction effect between different spacing and nipping treatments was found non-significant with respect to haulm yield.

Table 4: Yield attributes and economics of horsegram as influenced by spacing and nipping

Treatment	Number of pods per plant	Pod weight per plant (g/plant)	Seed yield (kg/ha)	Haulm yield (kg/ha)	Net realization (₹/ha)	Benefit: cost ratio (BCR)
Spacing (S)						
S_1: 30 cm × 10 cm	28.0	11.7	725	2615	12367	1.61
S_2: 45 cm × 10 cm	29.8	12.9	686	2562	11226	1.56
S. Em. ±	1.00	0.31	17.46	67	-	-
C.D. at 5%	NS	0.91	NS	NS	-	-
Nipping (N)						
N_1: No nipping	21.3	10.1	591	2191	7412	1.38
N_2: Manual nipping	22.7	11.2	634	2412	8407	1.41
N_3: CCC (Cycocel) spray @ 60 ppm	25.9	11.5	674	2479	10450	1.52
N_4: CCC (Cycocel) spray @ 80 ppm	31.6	12.9	709	2624	12019	1.60
N_5: Mepiquat Chloride spray @ 125ppm	34.6	13.6	756	2708	13851	1.68
N_6: Mepiquat Chloride spray @ 250ppm	37.4	14.7	870	3119	18680	1.91
S. Em. ±	1.73	0.54	30.24	115	-	-
C.D. at 5%	5.08	1.58	88.71	338	-	-
Interaction (S × N)						
S. Em. ±	2.45	0.76	42.77	163	-	-
C.D. at 5%	7.2	NS	125.46	NS	-	-
C.V. %	14.67	10.7	10.5	10.90	-	-

Table 5: Interaction effect of spacing and nipping on number of pods per plant of horsegram

	Nipping (N)					
Spacing (S)	**N_1: (No nipping)**	**N_2: (Manual nipping)**	**N_3: (CCC (Cycocel) spray @ 60 ppm)**	**N_4: (CCC (Cycocel) spray @ 80 ppm)**	**N_5: (Mepiquat Chloride spray @ 125ppm)**	**N_6: (Mepiquat Chloride spray @ 250ppm)**
S_1: 30 cm × 10 cm	23.0	24.8	27.7	30.4	30.9	31.4
S_2: 45 cm × 10 cm	19.6	20.6	24.0	32.8	38.4	43.4
S. Em. ±	2.5					
C.D. at 5%	7.2					
C.V. %	14.67					

Table 6: Interaction effect of spacing and nipping on seed yield (kg/ha) of horsegram

	Nipping (N)					
Spacing (S)	**N_1: (No nipping)**	**N_2: (Manual nipping)**	**N_3: (CCC (Cycocel) spray @ 60 ppm)**	**N_4: (CCC (Cycocel) spray @ 80 ppm)**	**N_5: (Mepiquat Chloride spray @ 125ppm)**	**N_6: (Mepiquat Chloride spray @ 250ppm)**
S_1: 30 cm × 10 cm	537	610	683	737	816	968
S_2: 45 cm × 10 cm	644	657	665	681	695	772
S. Em. ±	43					
C.D. at 5%	126					
C.V. %	10.50					

Economics

The data on net realization and benefit: cost ratio as influenced by different levels of spacing and nipping is presented in Table 4 and Table 7.

Net realization (₹/ha)

Among different spacing, horsegram sown at a spacing of 30 cm x 10 cm registered the highest net return (₹13027/ha). The foliar spray of mepiquat chloride @ 250 ppm recorded highest net returns (₹19340/ha). Higher net return was recorded with a spacing of 30 cm x 10 cm paired with foliar spray of mepiquat chloride @ 250 ppm (₹23341/ha).

Benefit: cost ratio (BCR)

The various spacing had influence on benefit cost ratio. The narrow spacing of 30 cm x 10 cm recorded higher BCR (1.66). Various nipping treatments had influence on benefit cost ratio. The crop spraying with mepiquat chloride @ 250 ppm recorded higher BCR (1.97). The higher BCR was recorded with a spacing of 30 cm x 10 cm coupled with foliar spray of mepiquat chloride @ 250ppm recorded highest BCR (2.16).

Table 7: Profitability of horsegram cultivation under different treatment combinations of spacing and nipping

Treatment combinations	Seed yield (kg/ha)	Haulm yield (kg/ha)	Gross realization (₹/ha)	Cost of cultivation (₹/ha)	Net realization (₹/ha)	Benefit: cost ratio (BCR)
S_1N_1	537	2272	24950	18990	5960	1.31
S_1N_2	610	2433	28046	20072	7974	1.40
S_1N_3	683	2501	30956	19683	11273	1.57
S_1N_4	737	2500	33006	19734	13272	1.67
S_1N_5	816	2615	36238	19856	16382	1.83
S_1N_6	968	3369	43522	20181	23341	2.16
S_2N_1	644	2110	28692	18543	10149	1.55
S_2N_2	657	2391	29748	19625	10123	1.52
S_2N_3	665	2456	30182	19236	10946	1.57
S_2N_4	680	2747	31334	19287	12047	1.62
S_2N_5	695	2800	32010	19408	12602	1.65
S_2N_6	772	2869	35074	19734	15340	1.78

Conclusion

On the basis of experimental results, it can be concluded that for horsegram, crop should be sown at a spacing of 30 cm × 10 cm along with nipping through foliar spray of mepiquat chloride @ 250 ppm at 55 DAS for obtaining higher yield and net realization.

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