Nipping and foliar spray for enhanced seed yield in Horsegram var. Paiyur 2

ABSTRACT

Horsegram (*Macrotyloma uniflorum*) is an underutilized food legume crop in the peninsular region and it belongs to the family *Leguminaceae* The lower production and productivity of horsegram is due to its cultivation in rainfed areas of marginal and sub-marginal lands with poor management practices. Nutrients given as foliar spray is a unique technique to enhance plant growth by extending the availability of nutrients at all growth stages. Exogenous application of PGR enhance the crop production by altering plant stand and quality. Hence, experiments were conducted by combining foliar nutrition with nipping to improve the seed yield and quality. Nipping in the company of foliar spray of brassinolide @1 ppm registered increased plant height, branches per plant, number of pods plant^{-1}, yield plant^{-1} over control. The yield increases due to nipping on 40th DAS was 7% over control whereas foliar spray of brassinolide @ 1.0 ppm during flowering phase enhanced the yield upto 10% when compared to control. The plants subjected to nipping at 40 DAS combined with foliar spray of brassinolide @1.0 PPM increased the yield up to 11% (779 kg/ha) over control (698kg/ha).

Keywords: Horsegram, nipping, plant growth regulator, foliar application, seed yeild

1. INTRODUCTION

Pulses are major source of protein in vegetarian diet. India is the largest producer and consumer of pulses in the world (Pooniya *et al.,* 2015). Pulses are recognized as the second most valuable plant protein for both human as well as animal nutrition (Bhat and Karim, 2009). The concentration of protein content is two times higher in legume seeds than cereals. Pulses are emerging as 'Future food 'in many developed countries.

Horsegram (*Macrotyloma uniflorum*) is extremely drought-resistant crop. Moderately warm, dry climatic conditions are suitable for its optimum growth Horsegram seed contains 57.2% of carbohydrate, 22% of protein, 0.50% of fat, 5.3% of dietary fibre, 6.77 mg of iron, 287 mg of calcium, 311mg of phosphorous and 321 mg of calories (Gopalan *et al.,* 1996). Besides its excellent nutritional value, it also grown as cover crop to maintain the soil fertility and to reduce the soil erosion[18-21]. Due to wider adaptability, it is grown under various climatic conditions in various places of India. Peninsular Indian region and Africa are said to be the centers of origin for horsegram. In India, horsegram is cultivated in 3.48 lakh ha and production of 2.26 lakh tonnes with productivity of 650 kg/ha.Karnataka have major area of production 1.47 lakh ha with production of 9.63 lakh tonnes. In Tamil Nadu, horsegram is cultivated in 0.8 lakh ha with productivity of 691 kg/ha (Indiastat,2020-21)

The growth habit of horsegram is indeterminate which leads to many physiological constraints, improper source sink relation throughout the growth period of the crop. The heavy competition between the overlapping vegetative and reproductive phases leads to increased pod abscission, poor harvest index and seed quality. Hence, raising productivity per unit area becomes only possible through high yielding varieties and advanced agronomic practices such as nipping and foliar application.

Nipping is an operation which includes the clipping or removal of the terminal bud that leads to initiation of lateral buds to produce many branches.This operation makes better source and sink relationship in the plant that ultimately leads to better manifestations of yield attributes. Nipping of foliage at vegetative stage of the crop could increase the number of branches by limiting profuse vegetative growth and thereby enhancing the yield. Pods per plant, seed yield per plant and seed yield per hectare were increased by terminal bud suppression.(Nayak *et al.,* 2017).

Foliar application is another fastest way to boost up crop growth in which nutrients are made available to plant at critical development stages. Foliar application is more economic, effective and protect soil environment by avoiding dumping of inorganic fertilizers through soil application. It has the advantage of efficient and quick utilization of nutrients, elimination of losses through leaching and fixation and regulating the uptake of nutrients by plant (Manonmani and Srimathi, 2009). The response of foliar nutrients in crop could be observed within 3 to 4 days after spraying. At vegetative stage, roots are not well developed, foliar application is more advantageous in absorption than the soil application. Addition of foliar application at proper stage significantly increasing the seed yield by delaying the leaf senescence (Kalita *et al.,* 1994). Hence, the present study was undertaken to study the performance of horsegram under different time of nipping practices followed by foliar application on seed yield and quality under changing climatic conditions for sustainable global agriculture production

2. MATERIAL AND METHODS

The field experiment was conducted in “B” block of Agricultural College & Research Institute, Madurai to determine the, effect of nipping and foliar nutrition on seed yield and quality of horsegram seeds at the Department of Seed Science and Technology, Agricultural College and Research Institute, TNAU, Madurai. The experimental plot is geographically located at 9^0 5’ north and 78^0.5’ east at an elevation of about 147 m above mean sea level. The fresh seeds of horsegram var. Paiyur 2 were collected from Regional Research Station, TNAU, Paiyur, Tamil Nadu. Employing the FRBD design, the study includes three replications with plots sized at 4 x 3m² and a spacing of 30 x 20 cm

Nipping of the terminal buds was done at 40 days after sowing (N_1) and the crop without nipping served as control (N0). Foliar spray of various growth regulators like DAP @ 1.0 % (F_1), Triacontanol @ 1.0 % (F_2), Nitrobenzene @ 0.3 % (F_3), Brassinolide @ 1.0 ppm (F_4), NAA @ 25 ppm (F_5), Ethrel @ 40 ppm (F_6) along with control (F0) were given at 50% flowering stage and second foliar spray was done with the 15 days interval from the first spray. Various observations like Plant height (cm), No. of branches per plant, Chlorophyll content (SPAD reading), Days to first flowering, Days to 50 % flowering, No. of pods per plant, Pod length (cm), Pod weight (g), No. of seeds per pod, Shelling percentage (%),100 seed weight (g), Seed yield plot^{-1} (g), Seed yield plant^{-1} (g), Seed yield ha^{-1} (kg) have been recorded. These observations were recorded replication wise on five randomly selected plants.

The data obtained from experiments were analysed by the ‘F’ test of significance following the methods described by Panse and Sukhatme (1978). Wherever necessary, the per cent values were transformed to angular (Arc-sine) values before analysis. The Critical Differences (CD) was calculated at 5 per cent probability level. The data were tested for statistical significance. If the F test is non-significant it was indicated by the letters NS.The CD and SEd values were given for analysed data which represented in each tables

3. RESULTS AND DISCUSSION

Horsegram is unexploited legume crop which offers more nutrients and minerals in the human diet. the present study on influence of nipping and foliar spray with growth regulators significantly enhanced the crop productivity and hence have the possible implications on the national food security and GDP in agricultural sector.Further one can explore these findings for other legume crops such as cowpea and other crops which having tendrils.However these experiment would be studied in different seasons and locations in order to find out the influence of changing environmental conditions.

In horsegram crop it was found that nipping of the terminal bud activates the dormant lateral buds for producing more branches and ultimately the seed yield was increased. Nipping changes both morphology and physiology of plants. Between nipping treatments higher plant height was recorded in without nipping N_0 (**73.95 cm**) than N_1 (**63.98** cm) at the time of harvest. Nipping recorded reduction in plant height due to the fact that horse gram is having the indeterminate growth habit and as such plants grow to their original height without reduction in unnipped

plants. This is in line with the findings of Obasi and Msaakpa (2005) in cotton and Aslam *et al*. (2008) in chick pea. Among the foliar treatments, the maximum plant height was registered in F_4 (**73.04 cm**) at harvest. Foliar application of nutrient improved plant height and it might be due to ready absorption of nutrients through leaves, enhancing the physiological process (Robredo *et.al.* 2007). It is assumed that brassinolide induced synthesis of both IAA and GA in plant body and increase in plant height was probably due to their cumulative action.

Nipping results in arresting of vertical growth and has stimulated the axillary buds and thus improved the side branches. More number of branches (**8.74**) was recorded with early nipping compared to without nipping (**7.65**). Similar results were observed by Kathiresan and Duraisamy (2001) and Arul (2014) in daincha. Tegelli *et al.,2020* recorded that Nipping significantly reduced the height of the plant and increased the number of primary and secondary branches and pods per plant Foliar application of Brassinolide increased the number of branches (**9.34**) further than all other foliar spray treatments. Minimum number of branches was recorded in control or no spray (**7.17**). number of pods per plant were present higher in nipping practices (**34.54**) compared with without nipping (**32.77)** Between foliar sprays, brassinolide @ 1.0 ppm (F_4) logged the highest number of pods per plant (34.99) followed by triacontanol @ 1.0% (F_2) (34.22) whereas the least number of pods was observed in control (F_0) (31.77) in Table 1

In interaction of nipping and foliar spray treatments, nipping with brassinolide @ 1.0 ppm (N_1F_4) (35.84) recorded the more number of pods per plant followed by nipping with triacontanol @ 1.0% (N_1F_2) (35.04) and less number of pods in without nipping with control (N_0F_0) (30.09).The seed yield and yield parameters were influenced due to interaction effects of nipping and foliar spray. However, among the interactions, it was evident that nipped plants sprayed with hormones had positive influence on yield compared to not nipped plants without hormonal spray. Similarly, the various seed yield traits were also higher in nipped plants sprayed with growth hormones

The significant higher seed yield recorded in nipped plants may also be attributed to diversion of photosynthates and metabolites produced by leaves to strong carbohydrate sinks that is pods, when compared to apical meristem in unnipped plants. Nipping increased the seed yield per plant (**6.24 g**) and the increase was 6 percent over without nipping (5.89g) This is in agreement with the findings of Kathiresan and Duraisamy (2001), Gopal (2012) and Arul (2014) in daincha; Venkadachalam (2003), Singh et al. (2013) in sesame and Reddy et al. (2009) in cowpea. Maximum 100 seed weight was registered in nipping (N_1) (3.460 g) whereas the least was recorded in without nipping (N_0) (3.446 g). The highest 100 seed weight was recorded in brassinolide @ 1.0 ppm (F_4) (3.466 g) whereas the least was recorded in control (F_0) (3.440 g).

In Table 2.The maximum seed yield per ha was recorded in nipping (N_1) (734 kg/ha) and minimum in without nipping (N_0) (689 kg/ha) while among foliar sprays, brassinolide @ 1.0 ppm (F_4) noticed the highest seed yield per hectare (745 kg/ha) followed by triacontanol @ 1.0% (F_2) (732kg/ha) and was the lowest in control (F_0) (678 kg/ha).In interactions, the maximum seed yield per ha was recorded in nipping with brassinolide @ 1.0 ppm (N_1F_4) (779 kg/ha) which was 18% higher than control (N_0F_0) (658 kg/ha). Hence Horsegram plants may increase the seed yield and

yield attributing parameters with practise of nipping. With addition to this practice foliar application of growth regulators at flowering particularly with brassinolide @ 1 ppm evolved additional increase in seed yield.

Fig. 1. Effect of nipping and foliar spray on seed yield/plant (g) and seed yield/ha (kg) of horsegram

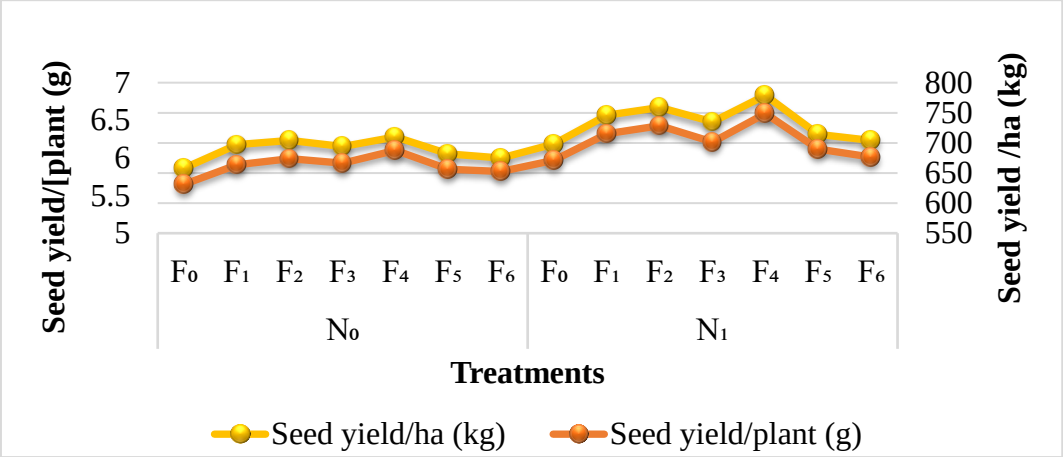

Table 1. Effect of nipping and foliar spray on growth parameters in Horsegram paiyur

Treatments	Plant height (cm)			Number of branches per plant			No. of pods per plant		
	N_0	N_1	MEAN	N_0	N_1	MEAN	N_0	N_1	MEAN
F_0	70.26	61.58	**65.92**	6.62	7.71	**7.17**	30.09	33.45	**31.77**
F_1	73.84	64.83	**69.34**	8.29	8.61	**8.45**	33.32	34.67	**34.00**
F_2	76.98	65.22	**71.10**	8.42	9.68	**9.05**	33.4	35.04	**34.22**
F_3	73.26	64.13	**68.69**	7.41	8.52	**7.97**	33.28	34.58	**33.93**
F_4	79.95	66.13	**73.04**	8.50	10.17	**9.34**	34.14	35.84	**34.99**
F_5	72.64	63.62	**68.13**	7.31	8.49	**7.90**	32.91	34.15	**33.53**
F_6	70.71	62.33	**66.52**	6.98	8.01	**7.50**	32.22	34.07	**33.15**
MEAN	**73.95**	**63.98**		**7.65**	**8.74**		**32.77**	**34.54**	
	N	**F**	**NXF**	**N**	**F**	**NXF**	**N**	**F**	**NXF**
SEd	0.35	0.72	0.92	0.07	0.13	0.18	0.15	0.28	0.39
CD (P=0.05)	0.72	1.34	1.89	0.14	0.27	0.38	0.30	0.57	0.80

Factor 1: Nipping N_0- Without nipping N_1- With nipping

Factor 2: Foliar spray treatment

F_0- Control F_1- DAP @ 1.0 % F_2- Triacontanol @ 1.0 %

F_3- Nitrobenzene @ 0.3 % F_4- Brassinolide @ 1.0 ppm F_5- NAA @ 25 ppm

F_6- Ethrel @ 40 ppm

Table 2. Effect of nipping and foliar spray on seed parameters in Horsegram Payiur 2

Treatments	Seed yield/plant (g)			100 seed weight (g)			Seed yield/ha (kg)		
	N_0	N_1	MEAN	N_0	N_1	MEAN	N_0	N_1	MEAN
F_0	5.65	5.97	**5.81**	3.437	3.443	**3.440**	658	698	**678**
F_1	5.91	6.32	**6.11**	3.448	3.465	**3.457**	697	746	**722**
F_2	5.99	6.43	**6.21**	3.451	3.468	**3.460**	704	759	**732**
F_3	5.93	6.21	**6.07**	3.446	3.460	**3.453**	694	735	**715**
F_4	6.10	6.59	**6.34**	3.457	3.475	**3.466**	710	779	**745**
F_5	5.85	6.12	**5.99**	3.443	3.458	**3.451**	682	714	**698**
F_6	5.82	6.01	**5.91**	3.441	3.450	**3.446**	675	704	**690**
MEAN	**5.89**	**6.24**		**3.446**	**3.460**		**689**	**734**	
	N	**F**	**NXF**	**N**	**F**	**NXF**	**N**	**F**	**NXF**
SEd	0.02	0.04	0.05	0.002	0.003	0.005	3	5	7
CD (P=0.05)	0.04	0.08	0.11	0.004	0.007	NS	5	10	14

Factor 1: Nipping

N_0- Without nipping N_1- With nipping

Factor 2: Foliar spray treatment

F_0- Control F_1- DAP @ 1.0 % F_2- Triacontanol @ 1.0 %

F_3- Nitrobenzene @ 0.3 %

F_4- Brassinolide @ 1.0 ppm F_5- NAA @ 25 ppm F_6- Ethrel @ 40 ppm

CONCLUSION

The study on horsegram (Macrotyloma uniflorum) showed that nipping the terminal bud significantly enhances seed yield and yield parameters by altering plant morphology and physiology. Nipping resulted in shorter plants with more branches (8.74 vs. 7.65) and a higher number of pods per plant (34.54 vs. 32.77) compared to unnipped plants. Foliar application of brassinolide at 1.0 ppm further improved these metrics, with the combination of nipping and brassinolide (N_1F_4) achieving the highest number of pods per plant (35.84) and seed yield per hectare (779 kg/ha). Thus, combining nipping at 40 days after sowing with foliar application of brassinolide @1.0 PPM during 50% flowering and 15 days interval of 1st spary is recommended for boosting horsegram productivity.

This study may be continued by studying in the different seasons and locations in order to investigate the influence of different environmental conditions.

Disclaimer (Artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

REFERENCES

1. Arul A. Effect of topping and foliar nutrition on seed yield and quality of daincha (Sesbania aculeata (Wild.) Pers.,). M.Sc., (Ag.) Thesis, TNAU, AC & RI, Madurai, 2014.

2. Aslam M, Khalil AH, Himayatullah K, Ayaz M, Ejaz M, Arshad M. Effect of available soil moisture depletion levels and topping treatments on growth rate and total dry biomass in chickpea. J Agri. Res. 2008; 46(3):229-243.

3. Bhat, Rajeev, and AA Karim. 2009. "Exploring the nutritional potential of wild and underutilized legumes." *Comprehensive Reviews in Food Science and Food Safety* 8 (4):305-331

4. Gopal M. Influence of topping and nutrient management practices on growth and seed yield of daincha (Sesbania aculeata (wild.) Pers). M.Sc., (Ag.) Thesis, TNAU, AC & RI, Killikulam, 2012.

5. Gopalan, C, B. V and Ramasastri, and S. C. Balasubramaniam. 1996. "Nutritive Value of Indian Foods." *NIN, Indian Council of Medical Research* (Hyderabad).

6. Indiastat.com.https://www.indiastat.com/table/agriculture-data/2/kulthi-horse gram/19568/1347635/data.aspx

7. Kalita, P, SC Dey, K Chandra, and LP Upadhaya. 1994. "Effect of foliar application of nitrogen on morpho-physiological traits of pea (*Pisum sativum*)." *Indian Journal of Agricultural Sciences (India)*.64(12):850-852

8. Kathiresan G, Duraisamy K. Effect of clipping and diammonium phosphate spray on growth and seed yield of dhaincha (Sesbania aculeata). Indian J Agron. 2001 46(3):568-572

9. Manonmani, V, and P Srimathi. 2009. "Influence of mother crop nutrition on seed yield and quality of blackgram."*Madras Agricultural Journal"* 96(1/6):125-128.

10. Nayak, Hari., K Durga, Kanaka.,, V. Bharathi, and K. Keshavulu. 2017. "Evaluation of Different Pinching Approaches on Seed Yield in Dhaincha." *Int. J. Curr. Microbiol. App. Sci* 6 (10):898-909

11. Obasi MO, Msaakpa TS. Influence of Topping, Side Branch Pruning and Hill Spacing on Growth and Development of Cotton (Gossypium barbadense L.) in the Southern Guinea Savanna Location of Nigeria. J of Agric. and Rural Development in the Tropics and Subtropics. 2005; 106(2):155-165

12. Panse, VC, and PV Sukhatme. 1978. "Statistical methods for Agricultural workers. III Rev." *Ed. ICAR, New Delhi*.

13. Pooniya, Vijay, Anil K Choudhary, Anchal Dass, RS Bana, KS Rana, DS Rana, VK Tyagi, and MM Puniya. 2015. "Improved crop management practices for sustainable pulse production: An Indian perspective." *Indian Journal of Agricultural Sciences* 85 (6):747-758

14. Reddy P. Effect of growth retardants and nipping on growth and yield parameters in cowpea (Vigna unguiculata L.). M.Sc. (Agri.) Thesis, Univ. of Agric. Sci., Dharwad, Karnataka (India), 2005

15. Robredo A, Pérez-López U, González-Moro MB, Lacuesta M, Mena-Petite A, Muñoz Rueda A. Elevated CO2 alleviates the impact of drought on barley improving water status by lowering stomatal conductance and delaying its effects on photosynthesis. Environ. & Exp. Bot. 2007; 59(3):252-263.

16. Venkadachalam K. Response of sesame cultivars to crop geometry and clipping managememt in tail end of Cauvery delta zone. M.Sc., (Ag.) Thesis, TNAU, Coimbatore, 2003

17. Teggelli, R. G., Yusufali, N., & Patil, M. C. (2020). Influence of nipping technology on growth, yield and economics of pigeonpea cultivated under rainfed situation. *Journal of Pharmacognosy and Phytochemistry*, *9*(2), 886-888.

18. A. Hussien, Rashad, Rama T. Rashad, Faten, A. El-Kamar, and Mohamed S. Mohamed. 2018. “The Effect of Some Growth Regulators Foliar Sprayed With the Fertilization by Fe and Zn on the Yield and Quality of Lentil Grown in Sandy Soil”. Asian Journal of Soil Science and Plant Nutrition 3 (2):1-10. https://doi.org/10.9734/AJSSPN/2018/42897.
19. Patel, Nihar A., R. M. Mangroliya, and J. J. Patel. 2022. “Role of Micronutrients Foliar Nutrition in Vegetable Production: A Review”. Journal of Experimental Agriculture International 44 (11):159-68. https://doi.org/10.9734/jeai/2022/v44i112062.
20. Sultana N, Ikeda T, Kashem MA. Effect of foliar spray of nutrient solutions on photosynthesis, dry matter accumulation and yield in seawater-stressed rice. Environmental and Experimental Botany. 2001 Oct 1;46(2):129-40.
21. Fageria NK, Filho MB, Moreira A, Guimarães CM. Foliar fertilization of crop plants. Journal of plant nutrition. 2009 May 14;32(6):1044-64.