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Research Communication

Impact of nipping on soybean (G*lycine max)* plant architecture, nodulation and yield

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ABSTRACT

An investigation was carried out during the rainy (*kharif*) season of 2011 at Raipur, Chhattisgarh to exploit suppressive apical dominance phenomenon through nipping to increase soybean [*Glycine max* (L.) Merr.] productivity. The experiment was laid in randomized block design with 3 replications. The treatments consisted of 7 nipping treatments, viz. nipping at 2-leaf stage, nipping at 4-leaf stage, nipping at 6-leaf stage, nipping at 2-leaf stage + nipping of lateral branches (15 days after 1 nipping), nipping at 4-leaf stage + nipping of lateral branches (15 days after 1 nipping), nipping at 6-leaf stage + nipping of lateral branches (15 days after 1 nipping) and control (without nipping). The same set of experiment was also conducted under pot culture in complete randomized design with 5 replication. Significantly higher number of branches, dry-matter accumulation and leaf-area index were obtained under nipping at 6-leaf stage + nipping of lateral branches (15 days after 1 nipping) than the other treatments. This was followed by nipping at 6-leaf stage. The number of nodules and dry weight of nodules were the maximum under nipping at 6-leaf stage + nipping of lateral branches (15 days after 1 nipping) followed by nipping at 6-leaf stage. Yield-contributing characters, viz. seed yield/plant, pods/plant, seeds/pod, 100-seed weight and seed yield, increased significantly under nipping at 6-leaf stage + nipping of lateral branches (15 days after 1 nipping) than other treatments.

Key words : Apical dominancy, Nipping, Soybean

Excessive vegetative growth in heavy rainfall areas and under irrigated conditions is one of the reasons for low productivity of soybean crop. The physiological reasons for variation in productivity may be attributed to poor source–sink relationship, poor translocation efficiency at later stages of crop growth, shedding of floral parts and low harvest index. There are some physiological techniques implied to increase the production of soybean. There is need to explore the advantage of simple agrotechnique like nipping, which suppresses the apical dominance and facilitates more lateral branches, ultimately resulting in more number of pod/plant. The active growth of terminal buds inhibits the development of lower axillary buds. This effect is called apical dominance. The apical meristem and young expanding leaves constitute a metabolic sink and auxin source that inhibit the outgrowth of lateral buds (Weiss and Shilo, 1988). Auxins exported from these tissues may limit xylem cytokinin concentrations and maintain apical control through a hormonal interaction (Bangerth, 1992). The plant hormone indole-3-acetic acid (IAA), a bioactive form of auxin, is found at high levels in the shoot apex. The IAA moves down the stem through the phloem and exerts an inhibitory effect. As a high concentration of auxin directly stimulates ethylene synthesis in lateral buds, causing inhibition of their growth and potentiation of apical dominance. Decapitation removes this 'source' of IAA, as the removal of the shoot tip causes a decline in IAA throughout the plant. Thus, IAA may be an inhibitor of bud outgrowth; removal of its inhibition releases axillary buds from dormancy. This process is related to a massive change in gene expression. The sprouting axillary bud quickly adapts its protein pattern to that in a terminal bud. Apex removal may be quantified as either a 'hard' or 'soft' pinch, and plant response to such decapitation may vary, according to the extent of tissue removal (Berghage *et al.,* 1989). This technique also allows the branches to grow more vertically, especially the uppermost one. To achieve optimum vegetative growth and to facilitate better translocation of phytosynthates in developing pods, nipping of plant may regulate plant

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growth and finally alter the plant architecture by increasing secondary branches and yield improvement appears to be an excellent tool. Thus, there is need to explore the possibility of enhancing the production of soybean especially under Chhattisgarh condition by adopting nipping of soybean plant to suppress the apical dominance. The seed yield performance of soybean is highly dependent on the balance between vegetative and reproductive growth. Foliage nipping at early stages of crop could increase number of branches while restricting profuse vegetative growth thereby promoting crop yield. This is an indigenous agro-technique to increase soybean production along with extra income out of nipped shoots. Nipping practice in the research area has two-fold advantages. On the one hand nipping at prescribed growth stages could improve yield of the crop while on the other hand during time the soybean in the field is usually a shortage of fodder and poor farmers could not afford to buy forage at distant locations, so soybean may provide them an opportunity to fetch green fodder for their livestock. Considering the facts, the investigation was conducted with the objective to find out the appropriate nipping practices for enhancing growth and productivity of soybean.

The investigation was carried out during rainy (*kharif*) season of 2011 at Research Farm and Glasshouse of Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh. The soil was of medium texture with low, medium and high N (220 kg/ha), P (12.5 kg/ha) and K (419 kg/ha). The climate of the region is sub-humid to semi-arid. The experiment was laid out in randomized block design with 3 replications. The treatments consisted of 7 nipping treatments, viz. nipping at 2-leaf stage, nipping at 4-leaf stage, nipping at 6-leaf stage, nipping at 2-leaf stage + nipping of lateral branches (15 days after 1 nipping), nipping at 4-leaf stage + nipping of lateral branches (15 days after 1 nipping), nipping at 6-leaf stage + nipping of lateral branches (15 days after 1 nipping), control (without nipping). The same set of experiment was also conducted under pot culture in complete randomized design with 5 replications. The size of pot was 0.5 m × 0.5 m × 1.0 m (w × l × d) filled with the 20 kg soil of the same field where field experiment was conducted. Soybean variety 'JS 97-52' was sown as a test crop on 30 June, 2011. Sowing was done with a seed–rate of 75 kg/ha at a spacing of 30 cm × 10 cm. The crop was harvested on 15 October, 2011. Data on plant height, number of branches, dry-matter accumulation and number and dry weight of nodules were recorded at different time intervals and number of branches, number of pods, number of seeds, pod weight, 100-seed weight, seed yield of crop were recorded at harvesting and statistically analysed.

Nipping treatments reduced the plant height significantly compared to the control. In field as well as in pot culture, significantly maximum plant height at harvesting was obtained under the control which was found comparable with nipping at 6-leaf stage, nipping at 4-leaf stage and nipping at 2-leaf stage. Significantly lowest plant height was recorded with nipping at 4-leaf stage + nipping of lateral branches (15 days after 1 nipping). Remaining treatments showed at par but significantly inferior plant height to control. The reduction in the height due to nipping that seems to have released the apical dominance and hence consequential increase in number of lateral branches. Similar results were obtained in pigeonpea by Sharma *et al*. (2003). The number of productive branches was significantly higher under treatment receiving nipping at 6-leaf stage + nipping of lateral branches (15 days after 1 nipping) under both the conditions, *i.e.* field as well as in pot culture. Number of branches/plant was more in case of nipped plants. This may be due to nipping effect of apical buds which resulted in production of more secondary branches and cessation of vertical growth on account of effective translocation of growth regulators particularly auxins being diverted to the potential and tertiary shoot buds which in normal conditions remain dormant. The dry-matter accumulation significantly increased by the nipping practice over non-nipping treatment. The nipping at 6-leaf stage + nipping of lateral branches (15 days after 1 nipping) showed the highest dry-matter accumulation. Kathireasan and Duraisamy (2001) indicated that the clipping either on 25 or 35 days after sowing significantly reduced the shoot length; but improved the dry weight of the shoot by increasing the branch numbers/plant.

Maximum leaf-area index (LAI) was recorded at 60 days and at harvesting by nipping at 6-leaf stage + nipping of lateral branches (15 days after 1 nipping) followed by nipping at 6-leaf stage. The significantly least LAI was recorded in the control (Table 1). Nipping significantly increased the LAI, compared to control at all the stages. Data indicated that effect of nipping on number and weight of root nodules/plant was not significant. It indicates that nipping did not affect number of root nodules of soybean (Table 1).

Maximum pods/plant were obtained under treatment nipping at 6-leaf stage + nipping of lateral branches (15 days after 1 nipping) and it was on a par with nipping at 6-leaf stage. Singh and Devi (2006) reported that the nipping of pea resulted in significantly higher number of branches/plant and pods/plant than the control. The seeds/pod were maximum under treatment nipping at 6-leaf stage + nipping of lateral branches (15 days after 1 nipping) and it was on a par with nipping at 4-leaf stage + nipping of lateral branches (15 days after 1 nipping), whereas under pot culture it was on a par with nipping at 4-leaf stage; and

Table 1. Effect of nipping practices on plant height, branches, dry-matter accumulation, leaf-area index, nodule number and weight, yield attributes and yield of soybean.

Treatment	Plant height (cm)		Branches/ plant		Dry-matter accumu-lation (g/plant) 40 DAS	Leaf-area index 40 DAS	Nodule/ plant 40 DAS	Dry weight of nodules (mg/plant) 40 DAS	Field condition			Pot culture			Field condition		Pot culture
	Field	Pot	Field	60 DAS					Pods/ plant	Seeds/ pod	100-seed weight (g)	Pods/ plant	Seeds/ pod	100-seed weight (g)	Seed yield (t/ha)	Harvest index (%)	Seed yield (g/ plant)
Nipping at 2-leaf stage	65.3	40.6	5.0	5.1	25.96	2.38	110.4	131.7	86.8	2.4	11.3	87.8	2.6	11.0	2.10	35.7	22.8
Nipping at 4-leaf stage	65.7	43.6	5.6	5.4	27.17	2.91	88.3	106.2	95.2	2.2	11.1	98.0	3.2	11.1	2.21	36.6	25.4
Nipping at 6-leaf stage	69.5	46.0	6.4	6.4	29.26	3.83	125.3	221.7	99.8	2.4	11.8	140.3	2.7	11.1	2.59	38.2	31.6
Nipping at 2-leaf stage + nipping of lateral branches (15 days after 1 nipping)	59.3	38.3	5.5	5.3	26.68	2.67	114.8	133.2	92.2	2.4	11.4	97.7	2.3	11.0	2.17	36.6	24.9
Nipping at 4-leaf stage + nipping of lateral branches (15 days after 1 nipping)	49.4	32.6	5.9	5.9	28.39	3.06	108.6	110.6	97.8	2.5	11.5	99.0	2.8	11.0	2.25	37.1	28.2
Nipping at 6-leaf stage + nipping of lateral branches (15 days after 1 nipping)	52.8	38.8	7.2	7.8	31.81	3.91	134.8	222.5	108.8	2.5	11.8	150.0	3.6	11.7	2.72	39.7	32.5
Control (Without nipping)	74.6	49.0	4.3	4.3	19.38	2.36	85.9	104.6	61.1	2.5	10.5	78.0	2.1	10.5	2.00	35.3	16.1
SEm±	3.90	1.39	0.40	0.51	2.09	0.27	15.2	31.5	3.45	0.05	0.26	9.99	0.24	0.21	0.151	0.86	1.47
CD (P=0.05)	12.0	4.24	1.24	1.57	6.45	0.83	NS	NS	10.6	0.16	0.81	30.3	0.75	0.63	0.465	2.66	4.45

DAS, Days after sowing

100-seed weight was higher under treatment nipping at 6-leaf stage + nipping of lateral branches (15 days after 1 nipping). The nipping is known to accumulate more photosynthates which are utilized for production of more number of pod-bearing branches and more number of seeds/pod in pea (Singh and Devi, 2006).

The highest seed yield was observed under nipping at 6-leaf stage + nipping of lateral branches (15 days after 1 nipping), which was statistically similar to nipping at 6-leaf stage. Under pot culture, the highest seed yield was observed under nipping at 6-leaf stage + nipping of lateral branches (15 days after 1 nipping), being statistically similar to nipping at 6-leaf stage and nipping at 4-leaf stage + nipping of lateral branches (15 days after 1 nipping). The yield/plant under pot culture showed similar results (Table 1). The seed yield is a function of pods/plant, seeds/pod and test weight. Arresting of vertical growth of plants by nipping apical bud always results in production of more number of productive branches. The increase in seed yield and yield-attributing parameters noticed with nipping was mainly owing to production of more number of productive branches (Khan *et al*., 2006) in chickpea. Seed yield itself is a complex genetic trait and several other parameters like branches/plant, days to flowering, number of pods/plant etc. have significant role on final yield. Sharma *et al*. (2003) noticed the increase in seed yield owing to significant reduction in plant height and increase in the number of primary and secondary branches and pods/plant in pigeonpea. Sarkar and Pal (2005) also reported similar findings. The highest harvest index was observed under nipping at 6-leaf stage + nipping of lateral branches (15 days after 1 nipping), which was statistically similar to nipping at 6-leaf stage and nipping at 4-leaf stage + nipping of lateral branches (15 days after 1 nipping).

Based on the present study it is implicit that nipping at 6-leaf stage + nipping of lateral branches (15 days after 1 nipping) followed by nipping at 6-leaf stage beneficial for obtaining more growth and yield of soybean grown under rainfed unbunded vertisols of Chhattisgarh plains.

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