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Standardization of nipping technique for enhancement of seed yield and quality in Dhaincha

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Abstract
During *Kharif*, 2019-20 and 2020-21, conducted a trail entitled "standardization of nipping technique for enhancement of seed yield and quality in dhaincha" was carried out at NSP, Seed Unit, UAS, Raichur. The findings showed that nipping at 30, 40, and 50 DAS (T_8) substantially influenced plant growth, seed yield and quality compared to no nipping.

Keywords: Nipping, cycocel and green manuring

Introduction
A traditional farming method for retaining soil fertility is called "green manuring." Contrary to that green revolution has reduced the use of green manures in intensive cropping systems while increasing the use of chemical fertilizers. Over time, the space beneath crops grown with green manure has shrunk, demonstrating this. According to estimates from 2015, green manure crops are expected to be grown on 1.23 million hectares of land in India.

Only 4.5 percent of the nation's net planted acreage, or 1.23 million hectares, is now used for green manuring during the Kharif season (Anon., 2015) [1]. The states that cultivate the most rice, AP, UP, Karnataka, Punjab, and Orissa - represent 41, 16, 11, 6, and 5 % of the nation's entire area under green manuring, respectively. While the percentages of Gujarat (3 %), M.P. (3 %), Himachal Pradesh (2%), and Haryana (1.7 %), among others, are not encouraging, ongoing efforts must be made at all levels to cover more land with green manuring, particularly when it is irrigated, in order to sustain agricultural yield and soil health.

Dhaincha, sunn hemp, wild indigo, pillipesara, cowpea, cluster bean, greengram, mung bean, and berseem are predominantly grown in India. Dhaincha (*Sesbania aculeata*), is the most imperative and widely grown green manure crop because of its ease of establishment, swift development, accumulation of large amounts of biomass, rich in nutrients, particularly nitrogen, in a short period of duration, and quick breakdown upon incorporated in paddy (puddle rice lands). In addition, it is ensuring for cultivation in salt-affected, ill-drained soils and high-rainfall areas (Parlawar *et al*., 2003) [10].

The major drawback of these crops is it has very poor seed multiplication rate. Nipping is a significant agronomic practice of eliminating the apical bud, which serves to reduce apical dominance, increase in branches, achieve a better source sink relationship, and enhance the per cent pod set and subsequently the yield is boosted. According to Reddy and Narayanan (1987) [11], nipping a sesamum plant's terminal bud caused the latent lateral buds to grow more branches, which ultimately increased productivity.

Nipping is a crucial agronomic technique that helps to lessen apical dominance by eliminating tendrils. These tendrils serve as a drain for the plant, which affects how photosynthesis is transferred to the reproductive organs. Pigeon pea tendrils can be clipped to boost the production of branches, the percentage of pods that are set, and the source-sink relationship, all of which boost yield (Arjun Sharma *et al*., 2003) [3]. Application of plant growth regulators aids in the efficient usage of metabolites in several physiological processes occurring in plant systems in addition to pinching practice (Antony *et al*., 2003) [2]. Cycocel, that slows vegetative growth and diverts nutrients to reproductive growth, has been found to be particularly effective at increasing yield and quality of some field and vegetable crops (Nerson *et al*., 1989) [9].

With the brief background, the present investigation opted to standardize the nipping technique for enhancement of seed yield and quality of dhaincha.

Materials and Methods

The above investigation, involving 15 treatments, conducted during 2019-20 and 2020-21 depicted in Table 1, such as nipping and foliar cycocel spray, in addition to their combinations, at different phases of crop growth. The study was taken in the open field with three replications using RCBD with 45 cm x 10 cm spacing and gross and net plot sizes of 4.5 m x 3.0 m and 3.6 m x 2.8 m, respectively.

The replicated mean data was subjected to statistical analysis, and the experimental data was interpreted by USI. In the F test, the level of significance was 5 per cent for field experiments and 1 per cent for lab experiments Gomez and Gomez (1984) [6].

Results and Discussion

Plant growth and seed yield parameters

From the combined data of two consecutive years presented in Table 2, 3 and 4 and depicted in Fig.1, 2 and 3. Nipping at 30, 40, and 50 DAS (T_8) showcased the significant reduction in plant height recorded at 60 DAS (132.8 cm) and at harvest (207.4 cm), greater count of branches per plant (13.0), highest number of days to achieve 50 per cent flowering (58.15) and maturity (135.83), maximum number of pods per plant (48.39) and seed yield (27.60 g plant^{-1} and 8.46 q ha^{-1}). Compared T_1 (no nipping) (156.2 cm at 60 DAS, 248.8 cm at harvest, 6.9, 48.76 days, 120.98 days, 25.36, 16.98 g, and 6.16 q ha^{-1}, respectively).

Nipping three times diminished the plant's ability to grow vertically. Dhaincha plant height was decreased by nipping. Because auxin (Indole Acetic Acid) is eliminated at the apical bud, which may explain why nipped plants are shorter than non-nipped plants in height. Which also triggered to outburst the numerous branches (Plate 1) that resulted in effective transport of growth regulators, particularly auxins, resulting in the development of additional branches and the cessation of vertical growth (Singh and Singh, 1992) [13] and delayed the flowering due to the expulsion of the section of the shoot that has reached maturity physiologically after apical dominance has been eliminated as a result, it took longer for the newly formed shoots on the nipped plants to enter the reproductive cycle and mature physiologically. Singh and Arora (1980) [12] and Beniwal *et al.* (2001) [4] made comparable findings in marigold.

The seed yield enhanced with nipping treatment. The number of pods per plant, branches per plant, chlorophyll content, pod yield per plant, dry matter production and seed yield per plant all surged as a result of nipping. This boosted seed output considerably. This is in accordance with outcomes from dhaincha investigations by Kathiresan and Duraisamy (2001) [8] and Dhedhi *et al*. (2017) [5].

Economics

Results on the cost of cultivation, gross returns, net returns, and B:C ratio of sunn hemp have been demonstrated to be substantially distinct among the treatments in 2019–20, 2020–21 and pooled data from the two seasons as a result of nipping and foliar usage of cycocel. Table 5 displays these outcomes.

Cost of cultivation, Gross returns, Net returns and Benefit cost ratio

Nipping at 30, 40, and 50 DAS observed greater cultivation costs (Rs. 48703 ha^{-1}) and maximum returns of Rs. 84650 ha^{-1}. Whereas, T_5 had significantly recorded greater net returns (Rs. 36971 ha^{-1}) and highest B:C ratio (1.80)· was noticed in T_5.

Seed quality parameters

Seed germination

The result of seed germination was presented in Table 6. The pooled analysis showed significant differences for seed quality parameters among the treatments. The maximum seed germination (85.7 %), TSL (19.9 cm), SDW (15.4 mg), SVI - I (1705) and II (1319) was recorded in nipping at 30, 40, and 50 DAS (T_8) compared to over T_1 (no nipping) which recorded lowest seed quality parameters (72.7 %, 12.8 cm, 10.2 mg, 940 and 740, respectively).

An essential seed quality criterion that influences how well a crop will grow in a stand is seed germination. The plants clipped at 30, 40, and 50 DAS (T_8) showcased maximum seed germination (%) (Plate 2) when compared to control, according to the aforementioned results (Fig. 4). The possible reason would be attributed to an increase in photosynthetic area, which would then result in a faster photosynthetic mechanism, absorption and an accumulation of more photosynthates, all of which would improve seed development. It might be because the seed developed better as a result of more store reserves being accumulated, which were then used for germination and seedling growth, resulting in the maximum shoot length and root length. Sudarshan (2004) [14] in fenugreek and Iyyanagouda (2003) [7] in coriander

Table 1: Treatment details of the experiment

T_1	Control (No Nipping)
T_2	Nipping at 30 DAS
T_3	Nipping at 40 DAS
T_4	Nipping at 50 DAS
T_5	Nipping at 30 and 40 DAS
T_6	Nipping at 30 and 50 DAS
T_7	Nipping at 40 and 50 DAS
T_8	Nipping at 30, 40 and 50 DAS
T_9	Foliar spraying of cycocel @ 1000 ppm at 30 DAS
T_{10}	Foliar spraying of cycocel @ 1000 ppm at 40 DAS
T_{11}	Foliar spraying of cycocel @ 1000 ppm at 50 DAS
T_{12}	Nipping at 30 DAS and foliar spray of cycocel @ 1000 ppm at 40 DAS
T_{13}	Nipping at 30 DAS and foliar spray of cycocel @ 1000 ppm at 50 DAS
T_{14}	Nipping at 40 DAS and foliar spray of cycocel @ 1000 ppm at 50 DAS
T_{15}	Nipping at 30, 40 DAS and foliar spray of cycocel @ 1000 ppm at 50 DAS

Table 2: Effect of nipping on plant height and number of branches in dhaincha

Treatments	Plant height (cm)									Number of branches per plant					
	30 DAS			60 DAS			At harvest			60 DAS			At harvest		
	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled
T_1	62.1	62.7	62.5	156.4	155.9	156.2	250.4	247.1	248.8	6.8	6.9	6.9	6.8	7.0	6.9
T_2	62.6	63.7	63.2	147.8	149.0	148.4	238.8	240.1	239.5	10.7	10.9	10.8	15.3	14.1	14.7
T_3	61.0	62.6	61.9	145.5	146.7	146.1	235.5	236.1	235.8	10.7	10.9	10.8	15.3	14.0	14.6
T_4	60.8	62.1	61.4	145.2	139.5	142.4	234.4	236.0	235.2	10.1	10.3	10.2	14.5	14.2	14.3
T_5	62.4	64.7	63.8	139.3	141.7	140.5	228.3	232.0	230.2	12.5	12.5	12.5	17.1	18.0	17.5
T_6	63.9	63.7	63.9	136.2	138.1	137.2	224.2	231.2	227.7	11.3	11.3	11.3	15.6	16.6	16.1
T_7	62.0	63.1	62.6	135.0	136.9	136.0	221.0	227.1	224.1	11.1	11.2	11.1	15.5	16.5	16.0
T_8	62.6	65.0	63.9	131.6	134.0	132.8	206.6	208.1	207.4	12.8	13.1	13.0	18.1	19.0	18.5
T_9	61.6	63.7	62.3	150.0	150.2	150.1	239.0	239.1	239.1	10.1	12.2	11.1	14.3	15.2	14.8
T_{10}	62.7	64.7	63.7	149.7	153.1	151.4	236.9	237.9	237.4	9.4	9.7	9.6	12.9	14.0	13.5
T_{11}	60.5	62.3	61.6	150.9	150.5	150.7	235.6	230.1	232.8	8.0	8.4	8.2	12.7	13.9	13.3
T_{12}	60.4	62.1	61.3	148.6	149.8	149.2	228.7	230.3	229.5	11.2	11.4	11.3	15.8	17.0	16.4
T_{13}	61.1	62.4	61.9	144.7	146.9	145.8	230.5	233.1	231.8	11.1	11.2	11.2	15.5	17.3	16.4
T_{14}	62.4	63.4	63.0	144.5	145.7	145.1	224.8	228.1	226.5	10.8	11.8	11.3	15.1	16.9	16.0
T_{15}	63.0	64.8	63.9	139.8	142.7	141.3	210.1	212.4	211.3	12.7	12.8	12.7	17.6	18.3	17.9
Mean	61.9	63.4	62.7	144.4	145.4	144.9	229.7	231.3	229.8	10.6	11.0	10.8	14.8	15.5	15.1
S.Em±	1.3	1.1	0.8	2.8	1.0	1.6	3.8	3.6	2.7	0.2	0.2	0.1	0.3	0.2	0.2
CD at 5 %	NS	NS	NS	8.0	2.9	4.6	10.9	10.4	7.9	0.4	0.5	0.3	0.7	0.6	0.5

Table 3: Effect of nipping on days to 50 per cent flowering and days to maturity in dhaincha

Treatments	Days to 50 per cent flowering			Days to maturity		
	2019	2020	Pooled	2019	2020	Pooled
T_1	49.01	48.50	48.76	121.06	120.89	120.98
T_2	53.00	53.65	53.33	126.34	125.32	125.83
T_3	53.00	52.85	52.92	128.80	128.12	128.46
T_4	54.66	54.71	54.69	129.89	128.98	129.44
T_5	56.40	55.91	56.15	132.10	133.11	132.60
T_6	55.66	55.71	55.69	133.28	133.12	133.20
T_7	56.66	56.38	56.52	133.50	132.99	133.25
T_8	58.33	57.98	58.15	135.68	135.98	135.83
T_9	50.66	50.16	50.41	121.66	122.10	121.88
T_{10}	50.66	50.24	50.45	121.66	124.05	122.86
T_{11}	53.66	53.24	53.45	128.92	122.42	125.67
T_{12}	55.33	54.99	55.16	131.30	129.01	130.15
T_{13}	55.33	55.01	55.17	131.66	131.24	131.45
T_{14}	56.00	55.98	55.99	131.93	131.42	131.68
T_{15}	56.64	56.68	56.66	134.28	132.98	133.63
Mean	54.33	54.13	54.23	129.47	128.78	129.13
S.Em±	0.76	0.78	0.52	2.06	1.88	1.37
CD at 5 %	2.21	2.26	1.51	5.96	5.45	3.98

Table 4: Effect of nipping on number of pods per plant and seed yield in dhaincha

Treatments	Number of pods per plant			Seed yield per plant (g)			Seed yield (q ha^{-1})		
	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled
T_1	51.95	53.23	52.59	16.86	17.10	16.98	6.10	6.21	6.16
T_2	59.20	60.01	59.61	20.89	21.89	21.39	7.24	7.22	7.23
T_3	57.80	58.89	58.35	20.66	22.60	21.63	7.14	7.17	7.15
T_4	56.98	57.91	57.45	20.59	22.48	21.53	7.03	7.12	7.07
T_5	69.47	70.12	69.79	22.46	23.46	22.96	8.31	8.28	8.29
T_6	68.20	67.28	67.74	22.20	23.10	22.65	8.10	8.08	8.09
T_7	62.60	63.71	63.15	21.28	22.04	21.66	7.94	7.99	7.96
T_8	65.00	66.32	65.66	27.22	27.98	27.60	8.43	8.50	8.46
T_9	55.20	56.34	55.77	20.56	21.88	21.22	6.36	6.39	6.37
T_{10}	54.60	56.71	55.65	20.56	21.72	21.14	6.33	6.35	6.34
T_{11}	54.20	55.32	54.76	21.08	22.91	22.00	6.31	6.28	6.29
T_{12}	67.00	69.72	68.36	21.96	22.80	22.38	8.02	8.04	8.03
T_{13}	63.80	64.89	64.35	21.23	22.70	21.97	7.82	7.88	7.85
T_{14}	60.40	62.64	61.52	21.20	22.42	21.81	7.36	7.39	7.37
T_{15}	71.00	72.01	71.50	26.69	27.88	27.29	8.34	8.31	8.32
Mean	61.16	62.34	61.75	21.70	22.86	22.28	7.39	7.41	7.40
S.Em±	0.85	0.97	0.74	0.33	0.35	0.25	0.14	0.11	0.12
CD at 5 %	2.46	2.82	2.13	0.95	1.01	0.72	0.42	0.31	0.34

Table 5: Economics of dhaincha seed production as influenced by nipping in dhaincha

Treatments	Cost of cultivation (Rs. ha^{-1})			Gross returns (Rs. ha^{-1})			Net returns (Rs. ha^{-1})			BC ratio		
	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled
T_1	39950	41117	40534	61000	62100	61550	21050	20983	21017	1.53	1.51	1.52
T_2	42673	43840	43257	72400	72200	72300	29727	28360	29044	1.70	1.65	1.67
T_3	42673	43840	43257	71400	71700	71550	28727	27860	28294	1.67	1.64	1.65
T_4	42673	43840	43257	70300	70200	70250	27627	26360	26994	1.65	1.60	1.62
T_5	45396	46563	45980	83100	82800	82950	37704	36237	36971	1.83	1.78	1.80
T_6	45396	46563	45980	81000	80800	80900	35604	34237	34921	1.78	1.74	1.76
T_7	45396	46563	45980	79400	79900	79650	34004	33337	33671	1.75	1.72	1.73
T_8	48119	49286	48703	84300	85000	84650	36181	35714	35948	1.75	1.72	1.74
T_9	41333	42500	41917	63600	63900	63750	22267	21400	21834	1.54	1.50	1.52
T_{10}	41333	42500	41917	63300	63500	63400	21967	21000	21484	1.53	1.49	1.51
T_{11}	41333	42500	41917	63100	62800	62950	21767	20300	21034	1.53	1.48	1.50
T_{12}	44056	45223	44640	80200	80400	80300	36144	35177	35661	1.82	1.78	1.80
T_{13}	44056	45223	44640	78200	78800	78500	34144	33577	33861	1.78	1.74	1.76
T_{14}	44056	45223	44640	73600	73900	73750	29544	28677	29111	1.67	1.63	1.65
T_{15}	46779	47946	47363	83400	83100	83250	36621	35154	35888	1.78	1.73	1.76
Mean	43681	44848	44265	73887	74073	73980	30205	29225	29716	1.69	1.65	1.67
S.Em±	-	-	-	1284	1232	1174	718	522	478	0.03	0.03	0.03
CD at 5 %	-	-	-	3720	3568	3400	1472	1512	1385	0.10	0.08	0.08

Table 6: Effect of nipping on seed germination, total seedling length and seedling dry weight in dhaincha

Treatments	Germination (%)			Total seedling length (cm)			Seedling dry weight (mg)		
	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled
T_1	71.8	73.6	72.7	12.6	12.9	12.8	10.1	10.3	10.2
T_2	80.4	82.6	81.5	15.3	15.6	15.5	12.3	12.5	12.4
T_3	79.1	81.1	80.1	14.3	14.7	14.5	12.3	12.6	12.5
T_4	77.4	77.7	77.5	13.8	14.4	14.1	12.0	12.1	12.1
T_5	83.9	85.7	84.8	18.9	19.4	19.1	14.1	14.4	14.2
T_6	83.9	85.1	84.5	18.6	18.9	18.8	13.7	13.9	13.8
T_7	82.9	83.1	83.0	17.4	18.0	17.7	13.2	13.4	13.3
T_8	84.6	86.9	85.8	19.7	20.0	19.9	15.2	15.5	15.4
T_9	76.3	77.2	76.7	13.7	14.0	13.8	11.7	11.8	11.7
T_{10}	76.3	78.7	77.5	13.2	13.4	13.3	11.1	11.3	11.2
T_{11}	74.1	76.1	75.1	12.8	13.2	13.0	10.5	10.8	10.7
T_{12}	83.7	84.7	84.2	17.8	18.3	18.1	13.4	13.6	13.5
T_{13}	81.7	83.1	82.4	16.6	17.0	16.8	12.9	13.1	13.0
T_{14}	80.8	82.8	81.8	15.0	15.3	15.1	12.7	12.9	12.8
T_{15}	84.1	86.8	85.4	19.3	19.8	19.6	14.2	14.6	14.4
Mean	80.1	81.7	80.9	15.9	16.3	16.1	12.6	12.9	12.7
S.Em±	1.3	1.3	0.9	0.1	0.2	0.1	0.1	0.2	0.1
CD at 1 %	4.8	5.0	3.2	0.6	0.8	0.5	0.3	0.7	0.3

Table 7: Effect of nipping on seedling vigour index as influenced by nipping in dhaincha

Treatments	Seedling vigour index - I			Seedling vigour index - II		
	2019	2020	Pooled	2019	2020	Pooled
T_1	928	952	940	721	758	740
T_2	1233	1287	1260	984	1034	1009
T_3	1127	1192	1159	975	1022	998
T_4	1066	1120	1093	924	944	934
T_5	1587	1658	1622	1186	1230	1208
T_6	1562	1610	1586	1147	1180	1164
T_7	1444	1498	1471	1091	1117	1104
T_8	1670	1740	1705	1288	1351	1319
T_9	1047	1078	1063	889	912	900
T_{10}	1004	1051	1028	844	889	867
T_{11}	950	1000	975	778	822	800
T_{12}	1493	1548	1521	1118	1152	1135
T_{13}	1355	1414	1385	1054	1088	1071
T_{14}	1210	1267	1238	1023	1068	1046
T_{15}	1626	1715	1671	1193	1268	1231
Mean	1287	1342	1314	1015	1056	1035
S.Em±	14	33	17	13	31	15
CD at 1 %	53	127	64	49	117	57

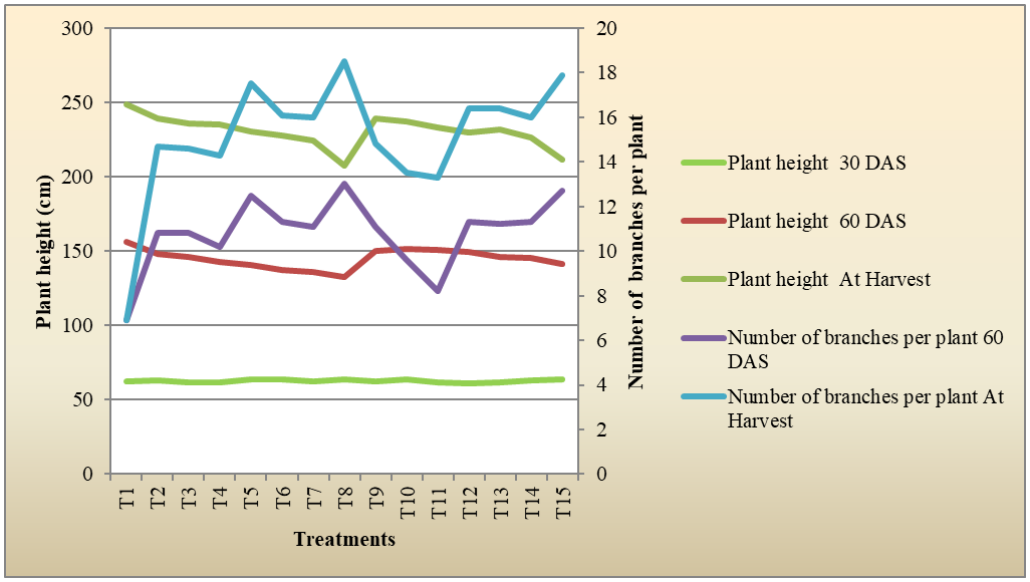

Fig 1: Plant height and number of branches per plant as influenced by nipping in sunn hemp

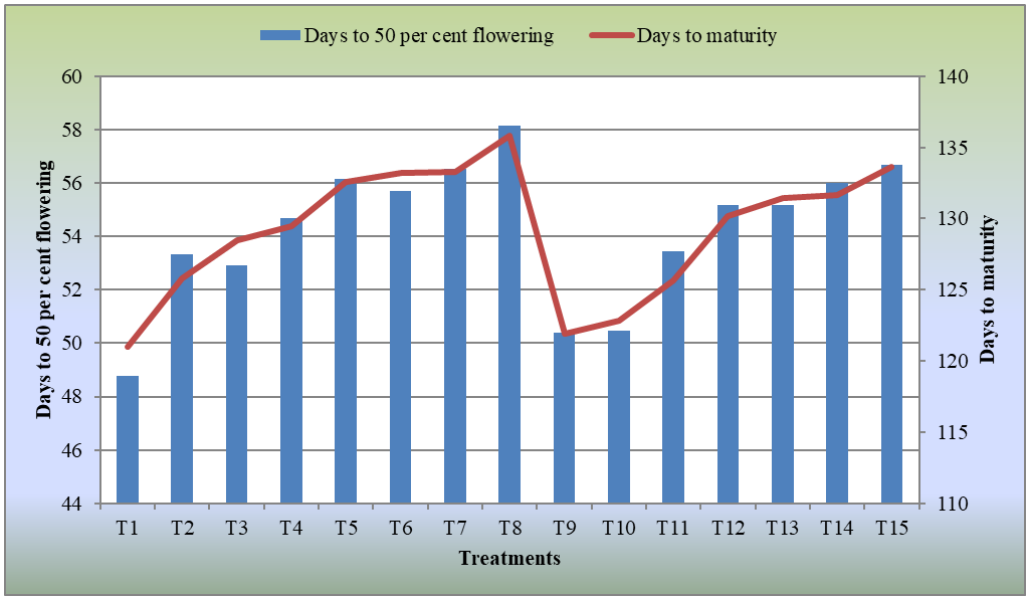

Fig 2: Days to 50 per cent flowering and days to maturity as influenced by nipping in Dhaincha

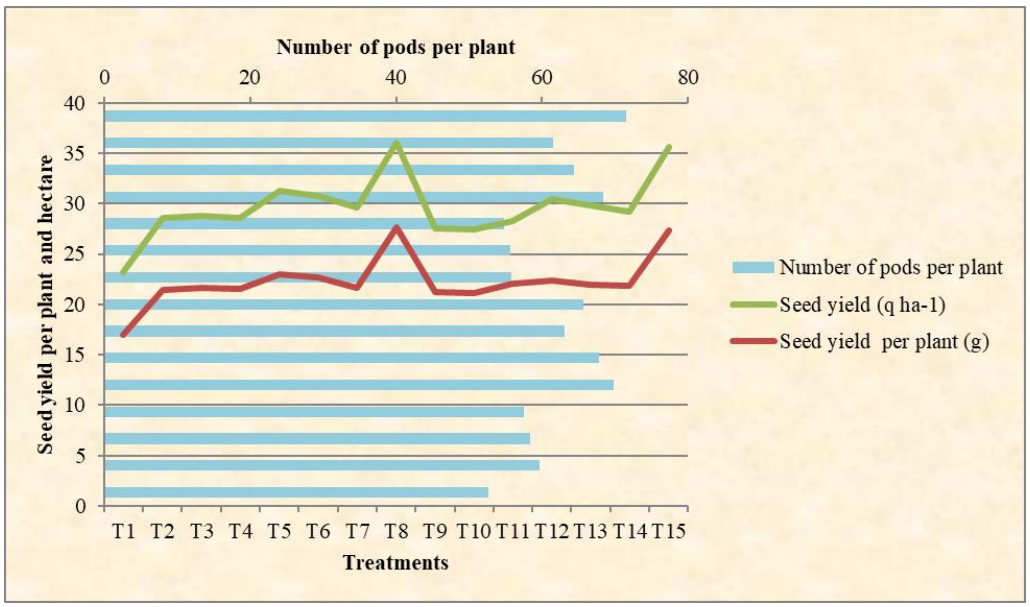

Fig 3: Number of pods per plant and Seed yield as influenced by nipping in Dhaincha

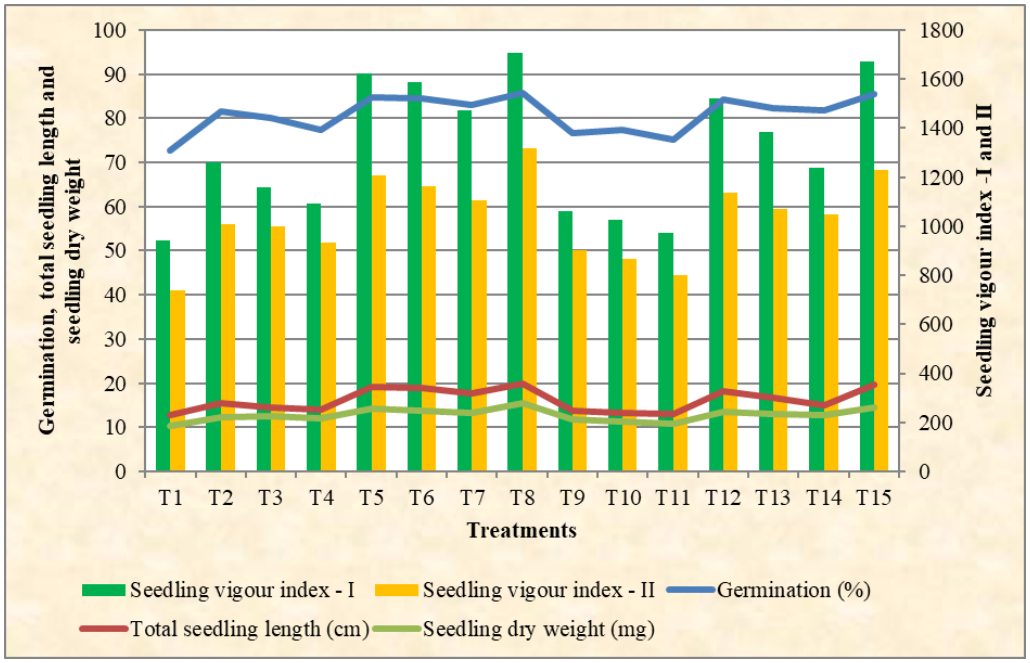

Fig 4; Seed germination, total seedling length, seedling dry weight, seedling vigour index I and II as influenced by nipping in Dhaincha

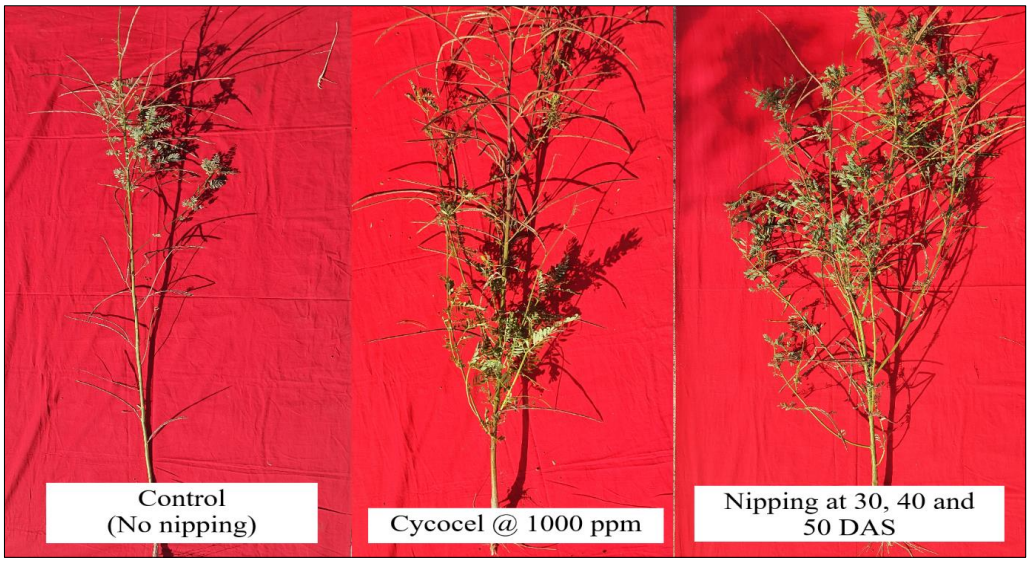

Plate 1: Effect of nipping on number of branches in Dhaincha

Plate 2: Effect of nipping on seed germination (%) in Dhaincha

Conclusion

Nipping at 30 and 40 DAS and 50 DAS, registered highest levels of growth, yield, and seed quality characteristics, including the maximum branches, leaf area, number of pods, seed yield with better seed quality parameters, including the highest seed germination (%), shoot length, root length, seedling dry weight and SVI of the produced seeds. As a result, it is regarded as the best and most advantageous procedure for nipping to obtain higher-yielding, higher-quality seeds in dhaincha. With regarding to nipping and foliar spray of cycocel the nipping at 30 and 40 DAS (T_5) is a better option for obtaining higher net returns and B:C ratio.

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