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Yield and Economics of Pea (*Pisum sativum* L.) as Influence by Spacing and Nipping in Manipur

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aims: To study the yield and economics of pea (*Pisum Sativum* L.) as influence by spacing and nipping in Manipur.
Study Design: Factorial randomized block design (FRBD).
Place and Duration of Study: Experimental field of College of Agriculture, Central Agricultural University, Imphal, Manipur, *rabi* season of 2013-14 and 2014-15.
Methodology: The treatment combinations involving two factors were S_1N_1, S_1N_2, S_2N_1, S_2N_2, S_3N_1, S_3N_2, S_4N_1 and S_4N_2 (Spacing i.e., S_1-20X15cm, S_2-20X20cm, S_3-30X10cm and S_4-30X15cm and nipping i.e., N_1-No nipping and N_2-Nipping.
Results: The pooled results of two years of study revealed that the yield differed significantly at a 5% probability level with different treatment combinations. The number of branches at harvest was significantly affected by both spacing and nipping with maximum branches in treatment combination S_4N_2 resulting in highest number of pods observed in S_4N_2 with 11.02 (pooled) and the

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lowest in S_1N_1. Spacing and nipping treatment had no significant influence on the pod length. The maximum stover yield was recorded in S_1N_2 with 27.35 q/ha and minimum in S_4N_1 with 22.02 q/ha. The highest seed yield of 16.05 q/ha was recorded in S_4N_2 with highest net return (₹ 2,05392/ha) and cost-benefit ratio (1:4.69). The present study suggests that the spacing of 30x15cm with nipping was found to be the best amongst the treatment combinations in regards to yield and higher feasible net returns.

Keywords: Pea; yield; economics; spacing; nipping.

1. INTRODUCTION

Pea (*Pisum Sativum* L.) is an important pulse crop of India grown during rabi season. Peas are cultivated for the fresh green seeds, tender green pods, dried seeds and foliage (Duke) [1]. Like any legume crop, pea is an integral component of sustainable agriculture due to its soil enriching and conditioning properties. Pulses are important sources of dietary protein for a majority of the Indian population. They are highly nutritive and contain high proportion of digestible protein, carbohydrates, minerals and vitamins. It is the richest source of protein, i.e., 18-35 % in dry seeds. It contains a high proportion of minerals and a good source of vitamins A, B and C (Khvostova) [2].

In Manipur, since time immemorial, as a tradition nipping of peas was done at initial stage of growth which improve the yield and provides additional income by selling nipped shoots as leafy vegetable. Some of the local cultivar of peas in Manipur are *Makuchabi, Makhyatmubi, Ningtekpi*, etc. They are grown mainly during winter. However, in the Hilly tracts of the state where cool weather prevails throughout the year, pea is traditionally cultivated all the year round for a sustainable crop production. It is essential to provide optimum plant population density per unit area by adjusting the spacing levels in pea crop unlike in normal spacing the plants grown in closer spacing exhibited more vertical growth but give less yield and poor-quality seeds for need of sufficient space, light, nutrient and moisture due to heavier plant population pressure. Among various components of agro-techniques, identification of optimum plant population per unit area plays a vital role in maximizing pea seed yield as well as its quality (Saimbhi and Gill) [3]. Among several seed production approaches, apical bud nipping is being commonly practiced in several crops to increase the seed yield and quality. The studies on influence of nipping on seed yield and economics are absolutely very scanty. Keeping in view of the above aspects, the present investigation has been undertaken to find out the yield and economics of pea (*Pisum Sativum* L.) as influence by spacing and nipping.

2. MATERIALS AND METHODS

A field experiment was conducted at College of Agriculture, Central Agricultural University, Imphal during the *rabi* seasons of 2013-14 and 2014-15, situated at about 24°46' N latitude and 93°54' E longitude and an altitude of about 790 metre above MSL. The soil was clay in texture, acidic soil pH, medium in organic carbon (0.58%) content, medium in available nitrogen (280.53 kg/ha), medium in available P_2O_5 (18.45 kg/ha) and medium in K_2O. During the period of growing season, minimum temperature was found to be 4.56°C in the month of January for the first year (2013-14) and 6.2°C in the month of December for the second year (2014-15) and a maximum temperature of 27.97°C (2013-14) and 28.5°C (2014-15) in the month of march. A maximum rainfall of 47.5mm (2013-14) and 213.4 (2014-15) was recorded in the month of April but there was no rain during the month of November to January. A recommended dose of fertilizers 20:40:20 in the form urea, single super phosphate and muriate of potash were applied as basal. The experiment was laid out in FRBD with 8 treatments and 3 replications. The treatment combinations involving two factors i.e., 1) Spacing: S_1-20x15cm, S_2-20x20cm, S_3-30x10cm and S_4-30x15cm and 2) Nipping: N_1-No nipping and N_2-Nipping were S_1N_1, S_1N_2, S_2N_1, S_2N_2, S_3N_1, S_3N_2, S_4N_1 and S_4N_2. The selected cultivar for the experiment was Pea (*Pisum sativum* L. subsp. hortense, local cultivar-*Makhyatmubi*. Five plants from each plot were selected randomly excluding border rows plants and were tagged properly for taking observations.

3. RESULTS AND DISCUSSION

3.1 Influence of Spacing on Yield and Attributes

In crops like pea (*Pisum sativum*), seed yield is a function of plant growth, number of productive

branches, number of pods per plant, seeds per pod, seed yield, etc. Effect of spacing and nipping influenced the yield and yield attributes of pea and are presented in Table 1. On an average, plants of wider spacing 30x15cm (S_4) recorded significantly more number of pods per plant of 9.58 (pooled data) while minimum number (6.50) were recorded in the spacing 20x15cm (S_1). The increase in the number of pods per plant in wider row spacing may be due to vigorous plant growth producing more number of productive branches which resulted in higher pod yield. On the other hand, in closer row spacing, the plant growth was limited resulting in less number of pods per plant. These results are in agreement with the findings of Monalisa et al. [4] in pigeon pea, Shajid et al. [5] in pea, Sharma et al. [6] in pigeon pea and Subedi et al. [7] in pea. They found the highest number of pods per plant in wider row spacing as compared to closer spacing.

The data on seed yield revealed that significantly maximum yield was recorded in the spacing 30x15cm (S_4) with 15.09 q/ha while minimum seed yield (10.01) was recorded in the spacing 20x15cm (S_1). The superior values of yield and its component per plant noticed under wider spacing may be attributed to be better growth and development of plants under less plant population density and it resulted into better source to sink relationship due to availability of balanced and adequate nutrients and better light, space and moisture unlike in narrow spacing. These results are in conformity with those of Ali et al. [8] in pea, Monalisa et al. [4] in pigeon pea and Subedi et al. [7] in pea.

Stover yield in pea plant differ significantly due to spacing. It was observed that the maximum stover yield was given by the spacing 20x15cm (S_1) with 26.93 q/ha while the minimum was recorded in the spacing of 30x15cm (S_4) with 23.09q/ha. The higher plant density per unit area and the higher plant height attributed to maximum stover yield in closer spacing among all the spacing treatments. The similar increase in stover yield with narrow spacing was observed by Derya [9] in peas, Luikham et al. [10] in broad bean and Taipodia and Nabam [11] in cowpea.

3.2 Influence of Nipping on Yield

The advantage of nipping to increase the number of productive branches, pods per plant and higher yield have been noticed in several field crops. In the present study, the terminal shoot tips of plants of the nipped treatments were nipped at 30 DAS and the resulting influence on the yield parameters and monetary benefits were studied. In the present investigation, nipped plants recorded significantly higher values for almost all the seed yield parameters. The higher number of pods per plant with 9.33, higher seed yield of 13.16 q/ha was recorded in the nipped treatment (N_2) compared to the non-nipped plants (N_1) giving 6.54 number of pods per plant and 10.99 q/ha seed yield. The increase in seed yield and yield attributing parameters noticed with nipping was attributed due to production of more number of productive branches in chickpea by Khan et al. [12]. Similar increase in seed yield and yield parameters with nipping were also reported by Reddy [13] in cowpea.

3.3 Interaction Effect of Spacing and Nipping on Yield

In the present investigation, the seed yield and almost all the yield parameters are significantly influence by the interaction between spacing and nipping. The maximum seed yield of 16.05 q/ha was obtained in the treatment combination of spacing 30x15cm (S_4) with nipping (N_2) and minimum (8.87 q/ha) at spacing 20x15cm (S_1) without nipping (N_1) amongst all the treatment combinations. The higher seed yield may be attributed due to more number of branches in the wider spacing and the nipped which encourage vigorous vegetative growth increasing the quantum of photosynthates production and translocation to sink which resulted in increased number of pods per plant. The finding is in agreement with Mazoka et al. [14].

The stover yield of pea crop increases with narrow spacing and with nipping. The maximum stover yield of 27.35q/ha (pooled data) were recorded in the treatment combination of spacing 20x15cm (S_1) with nipping (N_2) compared to all other treatment combinations. This may be due to markedly increased in plant density at narrow spacing and the increased in number of branches per plant on account of nipping at that particular spacing. These results are in accordance with the findings of Luikham et al. [10].

Table 1. Effect of spacing and nipping on number of pods per plant, pod length, yield and stover yield of pea

Treatment	Number of pods/plant			Pod length (cm)			Yield (q/ha)			Stover yield (q/ha)		
	Year 1	Year 2	Pooled	Year 1	Year 2	Pooled	Year 1	Year 2	Pooled	Year 1	Year 2	Pooled
Spacing												
S_1 (20x15cm)	6.47	6.53	6.50	7.83	7.92	7.88	10.05	9.96	10.01	26.81	27.04	26.93
S_2 (20x20cm)	7.4	7.78	7.59	7.95	7.9	7.93	11.19	11.32	11.26	25.62	25.7	25.66
S_3 (30x10cm)	8.02	8.1	8.06	7.98	7.9	7.94	11.96	11.92	11.94	23.63	24.01	23.82
S4 (30x15cm)	9.53	9.62	9.58	7.92	7.83	7.88	15.03	15.14	15.09	22.86	23.32	23.09
S.E. d (±)	0.09	0.11	0.06	0.04	0.05	0.19	0.17	0.12	0.15	0.53	0.34	0.25
CD (P=0.05)	0.37	0.34	0.17	NS	NS	NS	0.36	0.24	0.34	1.13	0.72	0.54
Nipping												
N_1 (Non-nipped)	6.43	6.64	6.54	7.88	7.88	7.88	10.96	11.02	10.99	23.9	24.35	24.13
N_2 (Nipped)	9.28	9.38	9.33	7.96	7.89	7.93	13.16	13.15	13.16	25.55	25.68	25.62
S.E. d (±)	0.09	0.08	0.04	0.03	0.04	0.2	0.12	0.08	0.1	0.37	0.24	0.17
CD (*P*=0.05)	0.26	0.24	0.12	NS	NS	NS	0.25	0.17	0.24	0.8	0.51	0.36
Treatment combinations												
S_1N_1	5.20	5.10	5.15	7.80	7.90	7.85	9.04	8.69	8.87	26.16	26.82	26.49
S_1N_2	7.73	7.97	7.85	7.87	7.93	7.90	11.05	11.23	11.14	27.45	27.25	27.35
S_2N_1	5.83	6.37	6.10	7.90	7.87	7.89	10.44	10.63	10.54	24.99	25.06	25.03
S_2N_2	8.97	9.20	9.09	8.00	7.93	7.97	11.93	12.01	11.97	26.25	26.34	26.30
S_3N_1	6.67	6.87	6.77	7.97	8.00	7.99	10.29	10.56	10.43	22.72	23.24	22.98
S_3N_2	9.37	9.33	9.35	8.00	7.80	7.90	13.63	13.27	13.45	24.53	24.78	24.66
S_4N_1	8.03	8.23	8.13	7.87	7.77	7.82	14.04	14.20	14.12	21.75	22.29	22.02
S_4N_2	11.03	11.00	11.02	7.97	7.90	7.94	16.02	16.08	16.05	23.98	24.34	24.16
S.E. d (±)	0.17	0.16	0.08	0.05	0.08	0.09	0.23	0.16	0.21	0.75	0.48	0.35
CD (*P*=0.05)	0.51	0.49	0.24	NS	NS	NS	0.5	0.34	0.49	1.61	1.03	0.75

Table 2. Effect of spacing and nipping on economics of pea

Treatment combinations	Nipped shoot yield (q/ha)	Return from nipped shoot (₹/ha)	Seed yield (q/ha)	Return from seed yield (₹/ha)	Total gross return (₹/ha)	Total cost of cultivation (₹/ha)	Net returns (₹/ha)	Benefit cost ratio
S_1N_1	0	0	8.87	1,33,050	1,33,050	48538	84,512	1.74
S_1N_2	2.08	8320	11.14	1,67,100	1,75,420	49663	1,25,757	2.53
S_2N_1	0	0	10.54	1,58,100	1,58,100	44338	1,13,762	2.57
S_2N_2	2.07	8280	11.97	1,79,550	1,87,830	45238	1,42,592	3.15
S_3N_1	0	0	10.43	1,56,450	1,56,450	48338	1,08,112	2.24
S_3N_2	2.1	8400	13.45	2,01,750	2,10,150	49238	1,60,912	3.27
S_4N_1	0	0	14.12	2,11,800	2,11,800	42938	1,68,862	3.93
S_4N_2	2.12	8480	16.05	2,40,750	2,49,230	43838	2,05,392	4.69

3.4 Effects of Spacing and Nipping on Economics

Effect of spacing and nipping on economics of pea are presented in Table 2. The treatment combinations involving wider spacing and nipping practice showed higher gross return, net returns and cost-benefit ratio over the narrow spacing without nipped treatments. In the present study, maximum gross return of ₹ 8,480 from shoot yield and ₹2,40,750 from seed yield per hectare, net returns and benefit cost ratio of ₹ 2,05,392 and 1:4.69 respectively were obtained in the treatment combination of spacing 30x15cm (S_4) with nipping (N_2). This may be attributed to the fact that at wider spacing, lower seed rate is required compared to narrow spacing under the same agronomic practices and nipping. This finding is also supported by Singh and Devi [15] in pea.

4. CONCLUSION

The result of this study reveals that the number of pods per plants recorded significantly higher at wider spacing with nipping treatment. The maximum numbers of pods and seed yield were recorded in the treatment combination S_4N_2 (30x15cm spacing with nipping) among all the treatment combinations and that of stover yield in the treatment combination S_2N_2 (20x20cm spacing with nipping). Careful study of data from the present investigation suggests that the spacing of 30x15cm with nipping was found to be the best amongst the treatment combinations in regards to better yield and higher feasible net returns.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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