Effect of plant geometry and nutrition on the phenological traits and chemical composition of pod of okra (*Abelmoschus esculentus* 'L') cv. Pusa Sawani

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ABSTRACT

The investigation were carried out with an objective to assess the "effect of plant geometry and nutrition on the phenological traits and chemical composition of pod in okra (Abelmoschus esculentus 'L' Moench) cv. Pusa Sawani" at the Department of Horticulture, C.S. Azad University of Agriculture and Technology, Kanpur during rainy season of two consecutive years 2003 and 2004. The experiment comprised four levels of nitrogen (0, 60, 90 and 120 kg ha-1), three levels of phosphorus (0,60 and 90 kg ha-1) and two plant spacing (30x40 and 40x40 cm) in Factorial experiment of Randomized Block Design with three replications. Application of 120 kg nitrogen ha-1 (N3) caused maximum days for first flower initiation (45.98 and 46.93 days), nitrogen content in pod (2.67 and 2.71 %), phosphorus content in pod (0.77 and 0.79 %) and protein content in pod (16.15 and 16.25 %) but maximum days for first fruit formation was observed with N0 treatment (48.13 and 49.08 days) during two years of respectively. 60 kg phosphorus ha-1 (P1) showed maximum days for first flower initiation (46.25 and 47.22 days). 90 kg phosphorus ha-1 (P2) caused to produce maximum nitrogen content in pod (2.36 and 2.38 %), phosphorus content in pod (0.84 and 0.86 %) and protein content of pod (15.06 and 15.14 %), but in this regard P0 treatment took maximum days for first fruit formation (47.18 and 47.25 days) during both corresponding years. Wider spacing (40x40 cm) presented maximum days for first flower initiation (46.78 and 47.73 days), nitrogen content in pod (2.46 and 2.49 %), phosphorus content in pod (0.78 and 0.81 %) and protein content of pod (15.63 and 15.71 %), whereas, maximum days taken for first fruit formation (47.10 and 48.01 days) with closer spacing (40x30 cm) during both the years of experimentation.

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Key words: Nitrogen, phosphorus, plant geometry, protein and first flower initiation

Introduction

Okra is an annual vegetable crop grown in tropical as well as subtropical regions. It is native of South Africa or Asia and belongs to family Malvaceae. It is sensitive to frost and extremely low temperature and for better growth and development a temperature between 24-28^{0}C is preferred. Due to high iodine content, fruit help to control goitre while leaves are used in inflammation and dysentery. The fruit also help in renal colic, leucorrhoea and general weakness. Fruits are rich in carbohydrates, protein and several minerals like sulphur, phosphorus, calcium and many vitamins. Nitrogen, phosphorus and plant density are important factors which are effecting to increase growth attributes, yield, as well as phenological traits and chemical composition of okra. High plant density also affects the above parameters directly by accommodation of greater number of plants and suppressing weed populations. In view of above beneficial fact research was conducted to study "effect of plant geometry and nutrition on the phonelogical traits and chemical composition of pod of okra".

Materials and Methods

The experiments were conducted in the garden of the Department of Horticulture, C.S. Azad University of Agriculture and Technology, Kanpur during the rainy season of 2003 and 2004. The soil of experimental field was of moderate fertility with pH of 7.60. The study comprised four levels of nitrogen (N_0, N_{60}, N_{90} and N_{120} kg ha^{-1}), three levels of phosphorus (P_0, P_{60} P_{90} kg ha^{-1}) and with two plant spacing (30x40 and 40x40 cm). Thus, there were 24 treatments replicated thrice in

Factorial Randomized Block Design. Certified seed of okra cv. Pusa Sawani was obtained from Vegetable Research Station, Kalyanpur, Kanpur. The N, P and K estimations of soil were made prior to experimentation. The plots were treated with folidol dust before sowing to prevent menace of termites. Application of manures and fertilizers were done as recommendation. The doses of nitrogen as per the treatment were supplied through urea, phosphorus and potash were applied through single super phosphate and muriate of potash, respectively through basal dressing. Half of N as per treatment was given as basal dressing prior to sowing and remaining half dose was given after one month of sowing as top dressing. Other intercultural operations were done as and when required. Observations on phenological traits were recorded by routine methods, whereas, nitrogen, phosphorus, and protein content of pods were estimated by Kjeldhal's method (A.O.A.C., 1984), as per suggestion of Yoshida *et al.* (1976) and by given formula protein content (%) = total nitrogen (%) x 6.25.

Results and Discussion

Table 1. Effect of plant geometry and nutrition on the phenological traits and chemical composition of pod of okra cv. Pusa Sawani

Treatments	Year 2003				
	Days for first flower initiation	Days for first fruit formation	Nitrogen content in pod (%)	Phosphorus content in pod (%)	Protein content of pod (%)
0 kg N ha^{-1} (N_0)	45.23	48.13	1.92	0.65	13.01
60 kg N ha^{-1} (N_1)	45.05	46.98	2.26	0.69	14.58
90 kg N ha^{-1} (N_3)	45.62	46.17	2.49	0.75	15.77
120 kg N ha^{-1} (N_3)	45.98	46.05	2.67	0.77	16.15
CD at 5 %	0.26	0.31	0.24	0.033	0.84
0 kg P ha^{-1} (P_0)	46.20	47.18	2.33	0.60	14.72
60 kg P ha^{-1} (P_1)	46.25	47.26	2.33	0.69	14.85
90 kg P ha^{-1} (P_2)	45.40	46.47	2.36	0.84	15.06
CD at 5 %	N.S.	0.27	0.29	0.029	0.73

Spacing 30x40 cm (S_1)	45.16	47.10	2.22	0.64	14.12
Spacing 40x40 cm (S_1)	46.78	46.72	2.46	0.78	15.63
CD at 5 %	0.18	0.22	0.17	0.023	0.59
Year 2004					
0 kg N ha^{-1} (N_0)	46.17	49.08	1.96	0.67	13.07
60 kg N ha^{-1} (N_1)	46.00	47.87	2.29	0.70	14.65
90 kg N ha^{-1} (N_3)	46.57	47.39	2.53	0.77	15.86
120 kg N ha^{-1} (N_3)	46.93	46.35	2.71	0.79	16.25
CD at 5 %	0.27	0.37	0.23	0.03	0.98
0 kg P ha^{-1} (P_0)	47.15	47.25	2.36	0.62	14.79
60 kg P ha^{-1} (P_1)	47.22	47.11	2.36	0.71	14.93
90 kg P ha^{-1} (P_2)	46.43	46.40	2.38	0.86	15.14
CD at 5 %	N.S.	0.32	0.20	0.03	0.84
Spacing 30x40 cm (S_1)	46.13	48.01	2.25	0.66	14.20
Spacing 40x40 cm (S_1)	47.73	47.65	2.49	0.81	15.71
CD at 5 %	0.19	0.26	0.16	0.02	0.69

Data influenced towards days taken to first flower initiation due to effect of different levels of nitrogen, phosphorus and plant density. It was marked that earliest flowering was noted when 60 kg N ha^{-1} was applied being 45.05 and 46.00 days was significantly lesser than the rest of nitrogen treatments during first and second years of investigation respectively. The next effective treatment was found to be 0 kg N ha^{-1} taking 45.23 and 46.17 days taken to first flower initiation being significantly at par with N_1 (60 kg N ha^{-1}) treatment during both the years. Incorporation of phosphorus fertilizer caused significant increase in the period required for first flower initiation during both the years. Early flower initiation was exhibited with P_0 treatment showing 46.20 and 47.15 days followed by increasing level 60 kg P ha^{-1} taking 46.25 and 47.22 days which were non-significant against P_0 treatment during both the years. Early flower initiation was affected by the use of closer spacing (30x40 cm) revealing 45.16 and 46.13 days, respectively, during both the years.

Days taken for first fruit formation in okra were influenced with application of nitrogen. Early fruit formation was obtained with 120 N ha^{-1}, presenting 46.05 and 46.35 days during first and second years of investigation and these values were significantly lesser than the rest of all nitrogen levels. The next lesser dose 90 kg N ha^{-1} took 46.17 and 47.39 days in the first and second year of study respectively. However, N_2 (90 kg ha^{-1}) and N_3 (120 kg N ha^{-1}), values did not differ significantly with this regard. Increasing levels of phosphorus induced early fruit formation during both the years of investigation. First fruit formation was observed with application of 90 kg P ha^{-1} taking 46.47 and 46.40 days, it was closely followed by 60 kg level requiring 47.26 and 47.11 days during first and second years respectively. Plant density brought significant difference in prolonging the days for first fruit formation during both the years of study. Wider spacing exhibited earlier (46.72 and 47.65 days) first fruit formation during both the years. Regarding phenological characters i.e. days taken to first flower initiation and days taken for first fruit formation, similar, findings were reported by **Abulsalecha and Shenmugelu (1988), Balasubramoni and Pappaih (1988), Gandhi *et al.* (1990), Singh *et al.* (1993) and Omotosa and Shittu (2008)** in okra.

Higher content of N was revealed at last picking of the pods of okra. Application of 120 kg nitrogen increased the nitrogen content in pods of okra (2.67 and 2.71 %) at last picking followed by 90 kg N ha^{-1} (2.49 and 2.53 %) during two years of study. The plants deprived of nitrogen showed the minimum content with control (N_0) showing 1.92 and 1.96 per cent in pods, it was significantly inferior over rest of N levels application during both the years. The application of phosphorus doses in increasing levels also increased the nitrogen content in pods significantly during both the years of trial. Incorporation of 90 kg P ha^{-1} recorded

2.36 and 2.38 per cent nitrogen content in pods. However, in this regard 0 kg and 60 kg P ha^{-1} showed at par values during both the years of investigation. Nitrogen content in pods of okra varied significantly due to involvement of narrow and wider spacing. Nitrogen content in pods of okra was recorded more (2.46 and 2.49 %) under 40x40 cm plant density during both the years. Similar, results have been forwarded by **Asif and Greig (1972), Mani *et al.* (1981)** in okra, **Singh *et al.* (1986), Singh and Srivastava (1988)** in chilies and **Dimari and Lal (1988)** in tomato.

Phosphorus content in pods of okra as influenced by different levels of nitrogen, phosphorus and plant density at last picking stage; application of 120 kg nitrogen increased 0.77 and 0.79 per cent phosphorus content in pods followed by its lower levels 90 kg and 60 kg ha^{-1}, revealing 0.75, 0.77 per cent and 0.69, 0.70 per cent phosphorus content in pods during both the years of investigation. Phosphorus content in pods due to 120 kg and 90 kg N ha^{-1} when compared with one another, it was found at par values during both the years of experimentation, but when compared with control (N_0), recorded 0.65 and 0.67 per cent phosphorus content in pods, it was found significantly increased during both the years of investigation. Application of 90 kg phosphorus ha^{-1} revealed maximum 0.84 and 0.86 per cent phosphorus content in pods followed by 60 kg phosphorus ha^{-1}, revealing 0.69 and 0.71 per cent phosphorus content while control (P_0) recorded 0.60 and 0.62 per cent phosphorus content in pods and it was found that significantly maximum phosphorus content was observed when compared with control (P_0) and 60 kg P ha^{-1} treatments during both the years of study.

At the last picking phosphorus content of pods of okra was also influenced due to plant densities. Greater quantity of phosphorus was recorded (0.78 and 0.81

%) under wider spacing 40x40 cm (S_2) being significantly superior over narrow spacing (0.64 and 0.66 %) during both the years of investigation respectively. The findings of the present investigation are in agreement with the reports of **Balasubrayamani and Pappaih (1988), Mani *et al.* (1981), Omotosa and Shittu (2008), Rajaraman and Pugalendhi (2013)** in okra and **Devi (1990)** in chilies.

Protein content in pod of okra was influenced significantly due to application of various levels of nitrogen. Maximum protein content (16.15 and 16.25 %) was estimated by the use of 120 kg N ha^{-1}, followed by N_2 and N_1 treatments showing 15.77, 15.86 per cent and 14.58, 14.65 per cent protein content during two years of trial, however, differences between N_2 and N_3 treatments were found to be non-significant at last picking stage. Phosphorus levels caused significant improvement in enhancing the protein content and maximum 15.06 and 15.14 per cent protein content were obtained by the use of 90 kg P ha^{-1}, followed by 60 kg P ha^{-1} (14.85 and 14.93 %) during both the years of study. Spacing also caused significant improvement. Wider spacing (40x40 cm) produced maximum protein (15.63 and 15.71 per cent) and it was superior over close spacing (30x40 cm), (14.12 and 14.20 per cent) during two years of investigation. These findings are in conformity with the reports of **Gandhi *et al.* (1990), Mani *et al.* (1981), Omotosa and Shittu (2008), Rajaraman and Pugalendhi (2013)** in okra and **Dimari and Lal (1988)** in tomato.

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