

EFFECT OF N, P AND K ON THE GROWTH AND YIELD OF CHILLI, VARIETY PANT C1*

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Chilli (*Capsicum annum* L.) otherwise known as red pepper is an important cash crop in India and is grown for its pungent fruits which are used both green and ripe (dried) to impart pungency to the food. As a condiment it has become indispensable in every Indian home. In Kerala, it is cultivated commercially over an area of 1200 hectares. Chilli being a tropical crop highly adapted to the warm humid tropical climate grows very well in well drained laterite, red loam and even sandy loam soils of Kerala, Chilli crop on marginal lands without manuring produces only very poor yield and the cultivation of this crop has not been economical in Kerala. Lower yield per hectare is due to a number of reasons such as unexploitation of the yield potential of high yielding varieties during favourable cropping seasons and unscientific management practices involving little manuring. Keeping this in view, an investigation was carried out to find out the optimum and economic levels of nitrogen, phosphorus and potassium during rainfed and irrigated crop seasons for a high yielding variety of chilli, Pant C1

Materials and Methods

The field experiments were conducted at the Instructional Farm of the College of Horticulture, Vellanikkara. The soil of the experimental site was deep, moderately well drained, clay loam with 0.075 per cent total N, 0.00023 per cent available P, 0.0087 per cent available K and pH 5.1. The treatments involved were three levels each of N (37.5, 75.0 and 112.5 kg/ha), P_2O_5 (20, 40 and 60 kg/ha) and K₂O (10, 20 and 30 kg/ha). The experiment was laid out in a 3³ confounded factorial design, partially confounding NP²K in replication I and NPK² in replication II. The entire doses of P and K and half the doses of nitrogen were given as basal dressing and the remaining half of N as top dressing, four weeks after transplanting. The first crop was rainfed and the second crop irrigated.

Thirty five day old seedlings of the variety Pant C1 were planted on 30th May 1981 and finally harvested on 15th September 1981 during the rainy season and seedlings of the same age and variety were planted on 21st November 1981 and finally harvested on 20th February 1982 during the irrigated summer season. The second crop was given irrigation daily during the first three weeks and once in every three days thereafter. Dry fruit yield and other components of yield were statistically analysed. The optimum doses of nutrients were estimated by finding the partial derivatives of the response function and equating each of them to zero. The economic doses of the nutrients were obtained by equating the marginal revenue to marginal cost.

Results and Discussion

Yield of dry fruits

Results obtained are given in Table 1. It is evident (Table 1) that application of 112.5 kg N/ha registered the highest yield and it was significantly superior to all the other levels of nitrogen during the rainfed season. During the irrigated season application of 75 kg N/ha gave the highest yield of 2077 kg and also was significantly superior to all the other levels of nitrogen. With 112.5 kg N/ha higher values were observed for number of fruits per plant, girth of fruit and weight of 100 dry fruits during the rainfed season. The observed higher number of fruits per plant at 75 kg N/ha contributed to higher yield during the irrigated season. Thus the influence of nitrogen in increasing the yield of chillies has been proved conclusively and this agrees with the conclusions arrived at by Mohammedkunj (1970) Covarelli (1976) and Khan and Suryanarayana (1977).

There was significant increase in yield with graded doses of P_2O_5 upto 60 kg/ha during both the seasons. The highest yields of 2235 kg and 1834 kg/ha respectively were obtained at 60 kg P_2O_5 /ha during the rainfed and irrigated seasons. The beneficial effects of graded doses of phosphorus in increasing branching, setting percentage and number of fruits per plant have contributed to increased yield. Since the soil is poor in available phosphorus good response to applied phosphorus was obtained during both the seasons. This is in conformity with the trials conducted by truthayaraj and Kulandaivelu (1973) and Khan and Suryanarayana (1977) where good response to applied doses of phosphorus was noted.

The treatment combination of 75 kg N/ha and 60 kg P_2O_5 /ha recorded the highest yields of 2532 kg and 2084 kg/ha respectively during the rainfed and irrigated seasons. Similarly lowest yields during both the seasons were noted with 37.5 kg N/ha in combination with 20 kg P_2O_5 /ha (Table 2). Similar interactional effects of nitrogen and phosphorus on yield have also been reported by workers like Lal and Pundrick (1971) and Gill *et al.* (1974).

Influence of potassium on yield of fruits was significant during both the seasons. The effects of potassium on yield at 20 kg and 30 kg per hectare were on par during both the seasons. Significant positive response to applied potassium at higher levels was observed on girth of fruits and weight of 100 dry fruits. Similarly higher values were also noted in length of fruits and number of fruits per plant at higher levels of applied potassium.

Optimum doses of nutrients

The quadratic response equation developed from the data for the rainfed crop is given below:

$$r = 1428.979 + 1152.797N + 312.704P - 33.169NP + 169.977K - 367.373N^2 - 82.443P^2 - 44.130K^2$$

The optimum levels of nitrogen, phosphorus and potassium for rainfed crop were 94, 52 and 30 kg per hectare respectively. The quadratic response equation

Table 1
Effect of N, P and K on yield and its components

Treatments	Yield of dry fruits (kg/ha)		Percentage of fruit set		Number of fruits per plant	
	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated
Nitrogen kg/ha						
37.5	1700	1364	77.68	52.06	63.25	51.90
75.0	2437	2077	84.01	56.70	88.15	73.38
112.5	2471	1978	83.60	57.03	88.63	71.98
(CD 0.05)	31.4	17.7	1.24	0.84	0.90	0.60
Phosphorus P_2O_5 kg/ha						
20	2065	1708	79.42	53.99	74.75	63.23
40	2248	1811	82.81	55.63	82.10	66.94
60	2295	1834	83.11	56.17	83.18	67.07
CD (0.05)	31.4	17.7	1.24	0.84	0.90	0.60
Potassium K_2O kg/ha						
10	2112	1730	81.50	55.22	79.62	65.60
20	2237	1803	81.62	55.21	79.97	65.64
30	2260	1820	81.22	55.36	80.46	66.01
CD (0.05)	31.4	17.7	NS	NS	NS	NS

(Table 1 contd.)

Treatments		Length of fruits, cm		Girth of fruits, cm		Weight of 100 dry fruits, g	
		Rainfed	Irrigated	Rainfed	Irrigated	Rainfed	irrigated
Nitrogen	kg/ha						
	37.5	6.65	6.56	3.36	3.32	54.55	53.48
	75.0	7.03	6.92	3.67	3.47	56.38	55.66
	112.5	7.00	6.88	3.69	3.50	56.42	55.87
	CD (0.05)	0.04	0.10	0.05	0.04	0.37	0.57
Phosphorus PA	kg/ha						
	20	6.84	6.70	3.51	3.37	55.71	54.66
	40	6.91	6.84	3.60	3.43	55.74	54.84
	60	6.92	6.81	3.60	3.49	55.85	55.50
	CD (0.05)	0.04	0.10	0.05	0.04	NS	0.57
Potassium K ₂ O	kg/ha						
	10	6.89	6.77	3.51	3.34	54.07	53.40
	20	6.89	6.78	3.57	3.72	56.27	55.62
	30	6.90	6.81	3.65	3.49	57.06	55.98
	CD (0.05)	NS	NS	0.05	0.04	0.37	0.057

developed for the irrigated chilli was

$$Y = 1202.1 + 1000.0N + 176.49P + 13.858NP + 122.12K - 16.157PK - 339.30N^2 - 41.670P^2 - 30.482K^2$$

The optimum doses of N, P₂O₅ and K₂O were 92, 52 and 26 kg/ha respectively. The predicted yields at the optimum doses of N, P₂O₅ and K₂O were in order of 2704.6 and 2159.6 kg/ha respectively during the rainfed and irrigated seasons

Economic doses of nutrients:

The economic doses of N, P₂O₅ and K₂O were estimated at the prevailing market rates of Rs. 7/kg dry chilli fruits, Rs. 4.44 kg N, Rs. 5.44 kg P₂O₅ and Rs 1.87/kg K₂O. The economic doses of N, P₂O₅ and K₂O per hectare during rainfed and irrigated crops were in the order of 94:52:30 and 92:52:26 kg respectively. The predicted total yield at the economic levels of N, P and K during the rainfed season was 2705 kg fetching a return of Rs. 7948, whereas the predicted yield for the irrigated chilli at the economic levels of the nutrients was 2160 kg, getting an amount of Rs. 4128. The differences between the most economic levels of N, P₂O₅ and K₂O between the rainfed and irrigated crops were 2:0:4 kg/ha. But the difference between the total predicted yields during the two seasons at the most economic levels of the nutrients was 545 kg. The additional cost spent on 2 kg nitrogen and 4 kg potassium during the rainfed season was only Rs. 16.36 compared to the cost of production during the irrigated season. But the additional return was Rs. 3798. Thus cultivation of the variety Pant C1 during rainy season is highly profitable.

Seasonal effects on yield of chilli:

The study clearly indicated that cultivation of chilli variety Pant C1 during the rainfed season from May to September produced higher yield compared to the same during the irrigated season i.e., November to February. Since the optimum

Table 2
Combined effect of N and P on yield of dry fruits (kg/ha)

Levels of P ₂ O ₅ kg/ha	Levels of N kg/ha						Mean	
	37.5		75.0		112.5		Rain-fed	Irrigated
	Rain-fed	Irrigated	Rain-fed	Irrigated	Rain-fed	Irrigated		
120	1522	1288	2311	1891	2363	1943	2065	1708
40	1757	1393	2469	2058	2516	1981	2248	1811
60	1822	1410	2532	2084	2532	2010	2295	1834
Mean	1700	1364	2437	2011	2541	1978	—	—
CD (0.05)	54	30.6	54.4	30.6	54.4	30.6	—	—

Table 3

Seasonal effect on mean setting percentage and number of fruits per plant

Treatments	Percentage of fruit set			Mean number of fruits per plant		
	Rainfed	Irrigated	Difference	Rainfed	Irrigated	Difference
$n_1p_1k_1$	75.66	50.71	2.95	55.8	49.1	6.7
$n_1p_1k_2$	76.00	50.54	25.46	58.0	49.7	7.3
$n_1p_1k_3$	75.83	50.60	25.23	57.5	48.8	8.7
$n_1p_2k_1$	77.33	51.77	25.66	64.5	53.0	11.5
$n_1p_2k_2$	77.66	52.36	25.3	66.5	51.7	13.8
$n_1p_2k_3$	79.33	52.61	26.72	66.3	54.1	12.2
$n_1p_3k_1$	78.66	53.41	25.25	67.8	53.4	14.4
$n_1p_3k_2$	80.0	53.9	26.61	67.1	53.5	13.6
$n_1p_3k_3$	78.66	53.21	25.45	67.8	53.8	14.0
$n_2p_1k_1$	81.33	55.14	26.19	83.0	69.2	13.8
$n_2p_1k_2$	82.83	54.88	27.95	83.64	69.7	13.9
$n_2p_1k_3$	80.83	56.08	24.75	82.3	70.0	12.3
$n_2p_2k_1$	83.16	57.23	25.93	89.1	74.8	14.3
$n_2p_2k_2$	85.3	57.04	28.26	90.8	75.5	15.3
$n_2p_2k_3$	85.49	57.77	27.72	91.8	76.0	15.8
$n_2p_3k_1$	87.16	56.79	30.37	90.5	74.4	16.1
$n_2p_3k_2$	84.16	57.80	26.36	90.7	75.5	15.2
$n_2p_3k_3$	85.83	57.55	28.28	91.6	75.3	16.3
$n_3p_1k_1$	79.66	56.48	23.18	84.9	70.1	14.8
$n_3p_1k_2$	79.16	55.74	23.42	83.5	70.6	12.9
$n_3p_1k_3$	83.49	55.75	27.74	85.2	71.9	13.3
$n_3p_2k_1$	86.33	57.17	29.16	89.7	73.4	16.3
$n_3p_2k_2$	85.49	57.33	28.16	90.7	71.5	19.2
$n_3p_2k_3$	85.16	57.30	27.86	90.5	72.5	18.0
$n_3p_3k_1$	84.16	58.25	25.91	91.3	73.0	18.3
$n_3p_3k_2$	83.99	57.74	26.25	90.8	73.1	17.7
$n_3p_3k_3$	85.33	57.42	27.91	91.1	71.7	19.4
t Value	8.47*			23.19*		

* (P < 0.05)

and economic levels of N, P and K did not vary much between the two seasons, the factor that contributed to the observed difference in yield between the seasons might be the varying climates that prevailed during the seasons. The main effects of the seasons were felt on the setting percentage and the number of fruits per plant (Table 3). During the rainfed season, forty well distributed rainfall of 2,437.4 mm was received on 79 rainy days whereas during the irrigated season the actual rainfall received

was only 2.2 mm. The range of maximum temperature during the rainfed season was between 27.5° C and 30.4° C while that in the irrigated season was between 30.9° C to 37.1 ° C. Weekly mean sunshine hours ranged between 0.4 and 6.3 during rainfed season whereas the same ranged between 6.7 and 10.2 during the irrigated season. The variation in the relative humidity observed during the rainfed season was between 79 to 92 percent and the same varied between 52 to 69 per cent during the irrigated season.

Summary

An experiment was conducted at the Instructional Farm of the College of Horticulture, Vellanikkara to study the effect of different levels of N, P and K on the yield of chilli variety, Pant C1 during rainfed and irrigated seasons. The most economic levels of N, P₂O₅ and K₂O were found to be 92:52:30 and 90:52:26 kg/ha respectively for the rainfed and irrigated chilli crops. By spending an additional cost of Rs. 16.36 on two kg N and 4 kg K₂O for the cultivation of chilli during the rainfed season compared to the cost of cultivation of chilli during irrigated season, an additional income of Rs. 3798 could be obtained. Cultivation of chilli variety Pant C1 is thus highly profitable during the rainfed season from May to September compared to the irrigated crop from November to February,

സംഗ്രഹം

വിവിധ അളവുകളിൽ പാക്യജനകം (ഹെക്ടറോന്നിന് 37.5, 75.0, 112.5 കിലോ (ഗ്രാം വീതം), ഭാവഹം (ഹെക്ടറോന്നിന് 20, 40, 60 കിലോഗ്രാം വീതം), ക്ഷാരം ഹെക്ടറോന്നിന് 10, 20, 30 കിലോഗ്രാം വീതം) എന്നിവ നൽകുന്നതുകൊണ്ട് പാന്ത് സി-1 എന്ന മുളകിനത്തിന്റെ വിളവിലും വിളവുല്പാദന ഘടകങ്ങളിലും ഉണ്ടാകുന്ന പ്രതികരണങ്ങൾ നിരീക്ഷിക്കുന്നതിനുവേണ്ടി പെള്ളാനിക്കര ഇൻസ്റ്റിറ്റ്യൂട്ടിൽ ഒരു പരീക്ഷണം നടത്തുകയുണ്ടായി. ഇതിൽനിന്നും പാക്യജനകം, ഭാവഹം, ക്ഷാരം എന്നിവ ഈ ഇനത്തിൽ വിളവിൽ പ്രതികൂല പ്രതികരണങ്ങൾ ഉണ്ടാക്കുന്നതായി മനസ്സിലായി. ഏറ്റവും ലാഭകരമായ വിളവിനുവേണ്ടി ഹെക്ടറോന്നിന് പാക്യജനകം, ഭാവഹം, ക്ഷാരം ഇവ യഥാക്രമം 92, 52, 30 കിലോഗ്രാം വീതം മഴക്കാല മുളകു കൃഷിക്കും, 92, 52, 26 കിലോഗ്രാം വീതം നനച്ചു ചെയ്യുന്ന മുളക് കൃഷിക്കും കൊടുക്കണമെന്ന് ഈ പഠനത്തിൽ നിന്നും വ്യക്തമായി. മുളക് കൃഷിക്ക് പാന്ത് സി-1 എന്ന ഇനം ഏറ്റവും യോജിച്ച സമയമായ മഴക്കാലത്ത് കൃഷി ചെയ്യുന്നതുകൊണ്ട് നനച്ചു കൃഷി ചെയ്യുന്നതിനെ അപേക്ഷിച്ച് 3798 രൂപ raw ധികമായി ലഭിക്കുന്നതായും കണ്ടു. എന്നാൽ മഴയെ മാത്രം ആശ്രയിച്ച് കാലവർഷാരംഭത്തിൽ നടുന്ന മുളക് കൃഷിക്ക് നവംബറിൽ നട്ടു നനച്ചു വളർത്തുന്ന കൃഷിയെ അപേക്ഷിച്ച് അധികമായി വേണ്ടിവരുന്ന രണ്ടു കിലോഗ്രാം പാക്യജനകത്തിനും നാല് കിലോഗ്രാം ക്ഷാരത്തിനും കൂടി ആകെ 13.36 രൂപ മാത്രമാണ് അധികച്ചെലവായിട്ടുള്ളത്.

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