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Differential response of nutrient management practices on different varieties in chilli-garden pea cropping system

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Abstract

The effects of diverse nutrient management practices on different varieties of chilli and garden were studied during two consecutive growing seasons of 2020-21 and 2021-22.The experiment consisted of 15 treatments was executed in vegetable-based sequence of chilli-garden pea following split plot design, replicated thrice. The main plot treatments were consisted of five nutrient management practices (75, 100 and 125% of recommended dose of NPK + 20 tonnes of farmyard manure ha^{-1}, organic and natural farming) and that of sub-plot treatment comprised of three varieties each of chilli (Him Palam Mirch-1, Him Palam Mirch-2 and Surajmukhi) and garden pea (DPP-SP-6, Him Palam Matar-1 and Punjab-89).The nutrient management practices comprising of application of farmyard manure plus synthetic fertilizers significantly improved the structural traits of both the crops in comparison to organic and natural farming practices. The results revealed that 125% of recommended NPK along with 20t farmyard manure ha^{-1} proved in general better for primary branches and plant height at different intervals than organic and natural farming practices in chilli and garden pea, and also that of nodes per plant and internodal distance in pea. Among the varieties, Him Palam Mirch-2 of chilli and DPP-SP-6 of pea performed significantly better for phenological and structural traits. It can be concluded that integrated use of farmyard manure with synthetic fertilizers resulted in better manifestation of these traits than organic and natural farming practices.

Key words: Farmyard manure, fertilizers, natural farming, organic farming, phenological, structural

Vegetables play a pivotal role in food and nutritional security of the ever increasing population of our country. The vegetarian society largely depends on vegetables for the want of their nutritional requirements. Vegetables are exhaustive crop with an exceedingly high turnover of plant nutrients, Thus, nutrient element required for optimum growth and development of vegetables should be supplied to soil and plants in right time and in a balanced and integrated mode. The growth of plants depends on the availability of nutrients from the soil which has to be supplied by suitable use of fertilizers. The application of fertilizers is one of the prime methods for improving the availability of soil nutrients to plants. Fertilizer application can positively change the plant characters, but indiscriminate use of fertilizers and chemicals causes increased risk of health hazards.

An imbalanced use of major nutrients in the intensive vegetable cropping system has caused multiple nutrient deficiencies due to the severe depletion of nutrient reserves of soil (Sharma *et al*. 2016). The use of chemical fertilizers to enhance soil fertility and crop productivity has often negatively affected the complex system of biogeochemical cycles (Chandel *et al*. 2022). For example, fertilizer use has caused leaching and run-off of nutrients, especially nitrogen (N) and phosphorus (P), leading to environmental degradation. Sole application of any plant nutrient through chemical fertilizers, organic manures, crop residues, or bio-fertilizers cannot meet the entire nutrient need of a crop in modern intensive agriculture. Therefore, there must be a balance

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between optimal nutrient use efficiency and optimal crop productivity (Sharma and Sharma 2016).

Intensive cropping systems with continuous imbalanced use of synthetic fertilizers to feed fertilizer-responsive varieties have caused losses in soil organic carbon and soil health, often leading to unsustainability of crop production systems. Keeping this in view, there is a need to follow integrated nutrient management practices that are practicable, economically viable, socially acceptable and ecologically sound. The use of organic sources of nutrients in agriculture is rapidly gaining favour but, owing to the problems related to the lack of availability of good quality and quantity of organic materials, the system may not be sufficient to achieve and sustain the production of vegetable crops in the amounts required for food security (Shilpa *et al*. 2022).

Another farming system known as Natural Farming being proposed by Padam Shri Sh. Subhash Palekar is finding its place on account of chemical free crop produce, soil conservation, household food autonomy, income and health besides reduced farm expenses. Scientific validation of different techniques of natural farming is required for further adoption.

Chilli and garden pea are considered as money-maker to the hill farmers as they fetch high remuneration. Chilli (*Capsicum annuum* L.) is one of the most important spice crops that require adequate soil nutrient supply for its best production. Pea (*Pisum sativum* L.) is a legume crop, one of the most sustainable vegetable crops grown in India. This legume contain high percentage of digestible protein (7.2 g), carbohydrates (15.8 g), vitamin A (139 I.U.), vitamin C (9 mg), magnesium (34 mg), phosphorus (139 mg) and essential amino acids per 100 g of edible portion (Sharma *et al*. 2022). Being a nitrogen-fixing plant, its value has long been recognized as a soil fertility building crop (Lalito *et al*. 2018). Both these crops respond well to the application of manures and inorganic fertilizers. Organic manures supply the major nutrients and improve many soil properties and its health. Keeping these aspects in view, the present investigation has been planned to study the response of different varieties of chilli and garden pea to diverse nutrient management practices to achieve better manifestation of phenological and structural traits that has impact on crop productivity and simultaneously sustaining soil health.

Materials and Methods

Field experiments were conducted at the Research Farm of the Department of Vegetable Science and Floriculture, College of Agriculture, Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya, Palampur during summer and winter seasons of 2020-21 and 2021-22. The Experimental Farm is situated about 1290 m above mean sea level at 32^o 6' N latitude and 76^o 3' E longitude. The soil of experimental field is moderately acidic in reaction, silty clay loam in texture, medium in organic carbon and also medium in available nitrogen, phosphorus and potassium.

The experiment consisted of 15 treatments which were applied in vegetable-based sequence of chilli-garden pea following split plot design, replicated thrice. The main plot treatments were consisted of five nutrient management practices *viz*., 20t farmyard manure ha^{-1} + 75% of recommended NPK (F_1), 20t farmyard manure ha^{-1}+ 100% of recommended NPK (F_2), 20t farmyard manure ha^{-1} + 125% of recommended NPK (F_3), Organic farming practice (100% N @Vermicompost at sowing + application of vermiwash at 10 days interval)[F4] and Natural farming practice (seed treatment with *Bizamrit* + soil application of *Ghanzivamrit* +Mulch + application of *Jivaamrit* at 10 days interval) [F_5] and three varieties each of respective crops in sub plots namely, V_1(Him Palam Mirch-1), V_2 (Him Palam Mirch-2) and V_3 (Surajmukhi) of chilli and V_1 (DPP-SP-6), V_2 (Him Palam Mater-1) and V_3 (Punjab 89) of garden pea. The experimental field was laid out in 45 plots of size 2.25 m × 1.8 m and these plots were remained fixed throughout the experimental period and were prepared manually afterwards by digging followed by levelling. The recommended farmyard manure @ 20 tonnes/ha was mixed in the designated plots as per treatments besides, vermicompost @ 10 tonnes/ha and *Ghanjeevamrit* @ 5tonnes/ha was added in the organic and natural farming treatment plots, respectively over the replications. The respective manures were added in the particular seasons of chilli and garden pea. The recommended dose of fertilizers for chilli @75:60:60 kg $N:P_2O_5:K_2O$/ha and that of garden pea @50:60:60 kg $N:P_2O_5:K_2O$/ha, respectively was applied in integrated nutrient management practices using synthetic fertilizers. The chilli seedlings of 10-15 cm height were transplanted in the field on 3rd May 2020 and 2nd May 2021 with inter and intra-row spacing of 45 cm each. Similaly, seeds of the respective garden pea genotypes were sown manually on 06th November 2020 and 2021 with inter and intra row spacing of 45 cm and 7.5 cm, respectively. The fertilizers were applied as per treatments *i.e.* 75%, 100% and 125% of recommended NPK dose through urea, single super phosphate and muriate of potash. Half of nitrogen, full dose of P and K was applied at the time of planting in chilli followed by half N in two splits at 30 days intervals after planting. On the other hand, full dose of N, P and K fertilizers was applied at the time of sowing in garden pea. The organic farming practice treatment was supplemented with 100% N through vermicompost @ 10tonnes/ha at planting/sowing followed by application of vermiwash (1:10 dilution) at 10 days interval. Similarly, natural farming practice comprised of mixing of *Ghanzivamrit* @ 5tonnes/ha in the soil of respective treatment plots. Besides, seed treatment was done with *Bizamrit* and organic mulch was applied to cover the soil for moisture conservation along with application of *Jivamrit* (1:10) at 10 days interval during the cropping season of both the crops.

The observations were recorded on randomly 5 plants of each genotype in each replication followed by computing their means for different phenological and structural traits of both the crops i.e. chilli (days to 50 % flowering, days to first picking, number of primary branches per plant and plant height in different intervals at 40, 80 and 120 days after planting) and garden pea (days to flowering, number of primary branches per plant, internodal length, nodes per plant and plant height in different intervals at 35, 70, 105 and 140 days).

Statistical analysis

The data obtained in various aspects in the present study was subjected to statistical analysis using split plot design of experimentations as per procedure suggested by Panse and Sukhatme (2000) using CPCS software. The treatment effects were compared at 5% level of significance, wherever, the effects exhibited significance at 5% of probability.

Results and Discussion

Chilli

The data presented in Table 1 showed that different nutrient management practices had no effect on the days taken to 50% flowering and first picking during both the years *i.e.* 2020 and 2021, and pool over years. Similarly, varieties namely, Him Palam Mirch 1, Him

Table 1. Effect of diverse nutrient management practices and varieties on phonological traits of chilli during 2020, 2021 and pooled over years

	Days to 50% flowering			Days to first picking		
Treatment	**2020**	**2021**	**Pool**	**2020**	**2021**	**Pool**
Nutrient management practices (F)						
75% NPK	46.22	45.89	46.06	57.78	57.89	57.83
100% NPK	46.44	46.00	46.22	58.11	58.11	58.11
125% NPK	46.89	45.78	46.33	58.56	59.33	58.94
Organic farming	46.78	46.00	46.39	59.00	59.33	59.17
Natural farming	48.22	46.78	47.50	59.89	59.78	59.83
SE(m) ±	0.74	0.41	0.51	0.76	0.77	0.58
CD ($P \leq 0.05$)	NS	NS	NS	NS	NS	1.33
Varieties (V)						
Him Palam Mirch 1	46.80	46.20	46.50	58.47	58.07	58.27
Him Palam Mirch 2	41.40	42.27	41.83	52.80	54.93	53.87
Surajmukhi	52.53	49.80	51.17	64.73	63.67	64.20
SE(m) ±	0.66	0.53	0.50	1.00	0.55	0.55
CD ($P \leq 0.05$)	1.37	1.10	1.04	2.09	1.14	1.15
F*V SE(m) ±	1.47	1.18	1.12	2.24	1.22	1.24
F×V	NS	NS	NS	NS	NS	NS

Palam Mirch 2 and Surajmukhi were statistically at par for both days to flowering and first picking over the years and pooled years. However, nutrient management practices had significant effect on days to first picking on pooling data over years. The minimum number of days to first picking were recorded in treatment of 75% of recommended NPK which was at par with 100% and 125% of recommended NPK but significantly better than organic and natural farming treatments. The earliness in flowering and subsequent first fruit harvesting could be attributed due to higher plant growth and improved source to sink ratio to sustain the soil fertility for longer duration and thus to harness the full potential of the crop (Pawar *et al*. 2017). The quicker augmentation of vegetative growth (buds) and storing sufficient reserved food materials for differentiation of buds into flower buds could be believed to be due to the earlier flowering and subsequent first harvesting process (Saboor *et al*. 2021).

The structural traits namely, primary branches/plant, plant height after 40, 80 and 120 days were significantly influenced by different nutrient management practices during 2020, 2021 and pooled over years (Table 2). Similarly, performance of varieties had also significant differences for primary branches/plant, plant height after 80 and 120 days in the respective years except during 2021 for plant height after 120 days. Interaction effects between nutrient management practices and varieties were significant only for plant height after 120 days during 2020 and pooled over years. The effect of different nutrient management practices revealed that 125% of recommended NPK had maximum primary branches per plant at par with recommended practice of 100% NPK but significantly better than 75% NPK, organic practice and natural farming during both the years and pooling data over years. The minimum plant height at different intervals of 40, 80 and 120 days after planting was recorded in natural farming practice whereas nutrient management practices supplemented with synthetic fertilizers recorded statistically similar but maximum plant height after 40 and 80 days than organic and natural farming during 2021 and pooled over years. Organic farming practice performed at par with treatments supplemented with synthetic

Table 2. Effect of diverse nutrient management practices and varieties on structural traits of chilli during 2020, 2021 and pooled over years

Treatment	Primary branches per plant			Plant height after 40 days			Plant height after 80 days			Plant height after 120 days		
	2020	2021	Pool	2020	2021	Pool	2020	2021	Pool	2020	2021	Pool
Nutrient management practices (F)												
75% NPK	3.92	3.67	3.80	13.87	14.47	14.17	49.92	47.4	48.68	77.21	74.20	75.71
100% NPK	4.63	4.56	4.60	14.83	14.42	14.63	52.29	46.3	49.28	75.59	72.82	74.21
125% NPK	4.70	4.65	4.67	15.04	14.60	14.82	49.63	47.8	48.70	77.56	75.13	76.34
Organic farming	3.69	3.62	3.65	13.70	11.34	12.52	48.41	39.2	43.80	72.92	72.67	72.79
Natural farming	1.64	1.60	1.62	12.94	9.78	11.36	42.77	31.9	37.33	55.00	58.67	56.83
SE(m)±	0.19	0.16	0.17	0.58	0.86	0.51	2.20	2.29	1.33	2.08	2.38	1.52
CD (P≤0.05)	0.44	0.37	0.39	1.34	1.98	1.17	5.06	5.29	3.06	4.79	5.50	3.50
Varieties (V)												
Him Palam Mirch 1	3.68	3.60	3.64	14.35	12.36	13.35	47.01	40.35	43.68	68.30	68.91	68.61
Him Palam Mirch 2	3.89	3.79	3.84	14.28	13.37	13.83	48.18	42.39	45.29	63.71	72.45	68.08
Surajmukhi	3.58	3.47	3.53	13.60	13.03	13.32	50.62	44.80	47.71	82.95	70.73	76.84
SE(m)±	0.09	0.08	0.07	0.71	0.43	0.49	1.31	1.28	1.10	1.61	2.17	1.33
CD (P≤0.05)	0.19	0.16	0.15	NS	NS	NS	2.73	2.67	2.30	3.36	NS	2.77
F×V	NS	NS	NS	NS	NS	NS	NS	NS	NS	7.52	NS	6.19

fertilizers for plant height at different intervals during 2020 and for plant height after 120 days of planting during 2021 along with pooled over years. Singh *et al.* (2022) also observed higher relative growth in maize using integrated nutrient management practice

Amongst the varieties, Him Palam Mirch 2 had significantly maximum primary branches per plant followed by Him Palam Mirch 1 and Surajmukhi during both the years and pooled over years (Table 3). For plant height, Surajmukhi recorded maximum plant height at 80 days after planting at par with Him Palm Mirch 2 during 2021 but significantly superseded both Him Palam Mirch 1 and Him Palam Mirch 2 for plant height after 120 days during 2020 and pooled over years.The straightforward impact of rising portions of nitrogen source (an integral part of protein and chlorophyll molecules), which leads to cell elongation, cell expansion, and cell proliferation, which could have enhanced the foliage of the crops and therefore augmented the photosynthesis process and inevitably synthesis of photosynthates, may well be the probable explanation for the strengthening of plant development (plant height and number of branches) with greater application of inorganic fertilizers. The increase in branch number caused by the simultaneous application of organic and inorganic fertilizers, might be attributable to a consistent delivery of critical nutrients and moisture to the crop (Fahad *et al.* 2015). In terms of vegetative development, the findings of this study are consistent with those published previously by Fahad *et al.* (2017), Bagale *et al.* (2014) in sweet pepper and Gosavi (2010) and Gautam *et al.* (2011) in tomato.

The interaction effects between nutrient management practices and varieties revealed significant differences for plant height after 120 days of planting during 2020 and pooled years (Table 4.3). Surajmukhi bore significantly maximum plant height when supplemented with 125, 100 and 75% NPK during 2020 and pooled over years while this variety grown under natural farming in pooled years also attained at par plant height as that of Surajmukhi with inorganic supplemented treatments. All three varieties attained minimum plant height under natural farming practice.

Table 3. Interaction effect of diverse nutrient management practices on plant height of chilli varieties during 2020 and pooled over years

Treatment	Plant height after 120 Days		
	Him Palam Mirch 1	**Him Palam Mirch 2**	**Surajmukhi**
	2020		
75% NPK	73.63	67.60	90.40
100% NPK	69.73	67.83	89.20
125% NPK	73.67	65.80	93.20
Organic farming	69.67	66.53	82.57
Natural farming	54.80	50.79	59.40
CD (P=0.05) For two sub plot levels at the same main level			7.52
For main at the same or different sub level			7.78
	Pooled over years		
75% NPK	73.77	69.72	83.63
100% NPK	67.63	72.92	82.07
125% NPK	74.40	71.60	83.03
Organic farming	68.80	70.47	79.12
Natural farming	58.43	55.69	56.37
CD (P=0.05) For two sub plot levels at the same main level			6.19
For main at the same or different sub level			6.14

Garden pea

The data presented in Table 4 showed that different nutrient management practices and varieties had no effect on the days to seed germination and percent plant population. Similarly, no significant effect was observed among different nutrient management practices for days taken to 50% flowering during the respective years though pooling data over years showed significant differences among them with minimum number of days to flowering was recorded in organic farming practices and 100% recommended NPK. The inorganic fertilizer treatments were found to be at par with one another for this trait. Among varieties, significant differences were recorded over years and pooled over years (Table 4) which showed that Him Palam Matar 1 and Punjab 89 were significant earlier than DPP-SP-6.

For days to first picking, significant differences among nutrient management practices were recorded during 2021-22 and pooled years. The minimum number of days to first picking was recorded in 75% NPK which was at par with 100% and 125% NPK but, significantly earlier in picking than organic and natural farming practices during 2020-21. Pooling data over years revealed that 100 and 75% NPK treatments were significantly earlier in picking over remaining nutrient management practices. The varieties revealed significant differences with Him Palam Matar-1 followed by Punjab 89 being earlier for days to first picking during 2021-22 and pooled years while DPP-SP-6 was significantly late in maturity in comparison to these varieties. The interaction effects between nutrient management practices and varieties were found to be non-significant for all the phenological traits. The earliness in flowering and subsequent first pod harvesting through integration of inorganic sources could be attributed due to higher plant growth and improved source to sink ratio which leads to early flower bud development. The results are in consistent with the findings of earlier researchers viz. Gul *et al*. (2006), Pawar *et al*. (2012) in pea.

Among the structural traits namely, number of nodes per plant, internodal distance, plant height at different intervals of 35, 70, 105 and 140 days were

Table 4. Effect of diverse nutrient management practices and varieties on phonological traits of garden pea during 2020-21, 2021-22 and pooled over years

Treatment	Days to Seed Germination			Plant Population (%)			Days to 50% Flowering			Days to First Picking		
	2020-21	2021-22	Pool	2020-21	2021-22	Pool	2020-21	2021-22	Pool	2020-21	2021-22	Pool
Nutrient management practices (F)												
75% NPK	15.78	17.80	15.80	77.43	74.31	75.87	82.78	83.56	83.17	117.91	110.11	114.01
100% NPK	15.00	17.60	15.00	77.43	76.39	76.91	81.33	83.44	82.39	115.56	110.78	113.17
125% NPK	16.11	17.90	16.10	78.47	75.35	76.91	82.22	84.33	83.28	118.44	112.11	115.28
Organic farming	13.00	15.20	13.00	77.08	76.04	76.56	80.44	82.33	81.39	119.56	114.22	116.89
Natural farming	14.00	15.90	14.00	76.39	76.74	76.56	83.33	84.00	83.67	119.89	113.78	116.83
SE(m) ±	1.08	1.66	1.32	1.99	2.66	2.10	0.86	0.87	0.49	1.29	1.19	0.70
CD(P ≤ 0.05)	NS	NS	NS	NS	NS	NS	NS	NS	1.12	NS	2.73	1.62
Varieties (V)												
DPP-SP-6	14.53	16.67	14.53	78.96	76.04	77.50	83.80	85.27	84.53	119.01	113.73	116.37
Him Palam Matar 1	14.80	17.00	14.80	77.08	75.83	76.46	81.00	82.47	81.73	117.53	110.80	114.17
Pb-89	15.00	16.93	15.00	76.04	75.42	75.73	81.27	82.87	82.07	118.27	112.07	115.17
SE (m) ±	0.45	0.45	0.37	1.79	1.33	1.21	0.50	0.48	0.31	0.93	0.81	0.69
CD(P ≤ 0.05)	NS	NS	NS	NS	NS	NS	1.04	1.00	0.66	NS	1.68	1.43
F×V	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

significantly influenced by different nutrient management practices and varieties during 2020, 2021 and pooled over years (Table 5 and 6). Interaction effects between nutrient management practices and

Table 5. Effect of diverse nutrient management practices and varieties on structural traits of garden pea during 2020-21, 2021-22 and pooled over years

Treatment	Number of primary branches/plant			Number of nodes/ plant			Inter nodal distance (cm)		
	2020-21	2021-22	Pool	2020-21	2021-22	Pool	2020-21	2021-22	Pool
Nutrient management practices (F)									
75% NPK	1.74	1.72	1.73	13.57	13.46	13.51	6.88	6.84	6.86
100% NPK	1.91	1.86	1.88	15.36	14.98	15.17	7.19	7.16	7.18
125% NPK	2.14	2.11	2.13	15.72	15.56	15.64	7.40	7.37	7.39
Organic farming	1.64	1.61	1.63	12.81	12.69	12.75	6.84	6.84	6.84
Natural farming	1.76	1.74	1.75	12.25	12.10	12.18	6.15	6.12	6.14
SE(m) ±	0.24	0.22	0.23	1.16	0.98	1.06	0.21	0.16	0.17
CD (P ≤ 0.05)	NS	NS	NS	NS	2.26	2.45	0.47	0.36	0.40
Varieties (V)									
DPP-SP-6	2.01	1.98	2.00	15.09	14.87	14.98	6.78	6.75	6.77
Him Palam Matar 1	1.80	1.78	1.79	13.73	13.58	13.66	6.86	6.85	6.86
Pb-89	1.71	1.67	1.69	13.00	12.82	12.91	7.03	7.00	7.02
SE (m) ±	0.09	0.09	0.09	0.34	0.30	0.30	0.07	0.09	0.06
CD (P ≤ 0.05)	0.19	0.18	0.18	0.71	0.62	0.62	0.14	0.18	0.13

Table 6. Effect of diverse nutrient management practices and varieties on plant height of garden pea crop during 2020-21, 2021-22 and pooled over years

Treatments	Plant height after 35 days of sowing (cm)			Plant height after 70 days of sowing (cm)			Plant height after 105 days of sowing (cm)			Plant height after 140 days of sowing (cm)		
	2020-21	2021-22	Pool	2020-21	2021-22	Pool	2020-21	2021-22	Pool	2020-21	2021-22	Pool
Nutrient management practices (F)												
75% NPK	26.11	22.36	24.24	53.46	49.85	51.66	75.46	70.93	73.19	82.69	79.83	81.26
100% NPK	26.73	22.72	24.73	54.06	51.69	52.88	78.49	73.76	76.13	84.27	82.15	83.21
125% NPK	27.18	23.72	25.45	54.84	52.15	53.50	80.56	75.78	78.17	86.10	84.56	85.33
Organic farming	23.02	21.54	22.28	49.72	43.61	46.67	69.17	64.60	66.88	72.37	68.94	70.65
Natural farming	21.01	19.22	20.11	40.79	38.14	39.46	52.92	49.70	51.31	60.81	57.53	59.17
SE(m) ±	1.39	0.59	0.82	1.20	1.38	1.21	1.23	1.09	1.14	1.74	2.94	2.25
CD(P≤ 0.05)	3.21	1.37	1.89	2.78	3.18	2.79	2.83	2.51	2.63	4.02	6.77	5.20
Varieties (V)												
DPP-SP-6	25.32	22.47	23.90	51.05	47.94	49.50	72.90	69.01	70.96	79.58	75.93	77.75
Him Palam Matar 1	24.37	21.43	22.90	50.43	47.09	48.76	71.35	66.80	69.08	77.36	74.98	76.17
Pb-89	24.74	21.84	23.29	50.24	46.24	48.24	69.71	65.05	67.38	74.80	72.90	73.85
SE (m) ±	0.74	0.31	0.45	0.74	0.81	0.72	1.40	1.18	1.26	1.17	1.56	1.28
CD (P≤ 0.05)	NS	0.64	NS	NS	NS	NS	NS	2.47	2.63	2.45	NS	2.68
F×V	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

varieties were non-significant for all structural traits over the years. Number of primary branches was not influenced by different nutrient management practices. However, varieties showed significant differences among themselves for this trait and DPP-SP-6 had significantly maximum number of branches per plant during both the years and pooled over years followed by Him Palam Matar-1 and Punjab 89.

Number of nodes revealed significant differences due to the influence of different nutrient management practices during 2021-22 and pooled years. The treatment supplemented with 125% NPK resulted in maximum number of nodes per plant though at par with 100 and 75% of recommended NPK during 2021-22 and pooled years but significantly better than natural and organic farming practices. Similar trends were recorded with significant differences among varieties for this trait during both the years and pooled years. The DPP-SP-6 recorded significantly maximum number of nodes per plant followed by Him Palam Matar-1 and Punjab 89 during both the years and pooling data over years.

The minimum internodal distance was observed in natural farming practice over all other nutrient management treatments. The maximum internodal distance was found in treatment supplemented with 125% NPK which was at par with 100% NPK. Among varieties, DPP-SP-6 and Him Palam Matar-1 showed significantly minimal internodal distance than Punjab 89 during both the years and pooled over years (Table 5).

The minimum plant height at different intervals after sowing was recorded in natural farming practice whereas nutrient management practices supplemented with synthetic fertilizers recorded statistically similar but significantly more plant height than organic and natural farming practices during 2020-21, 2021-22 and pooled over years (Table 6). The maximum plant height was recorded in treatment supplemented with 125% NPK over the years. Amongst the varieties, maximum plant height was recorded in DPP-SP-6 at different intervals over the years which were 77.75 cm after 140 days in pooled years at par with Him Palam Matar-1 but significantly higher than Punjab 89. In the present context, addition of inorganic manures recorded best results regarding the structural traits which may be attributed due to the conversion of the soil nutrients from unavailable to available forms (Mukherjee, 2016). This also helps in the carbon sequestration through increased photosynthesis and biomass production (Yogananda *et al*. 2020).

It can be concluded that farmyard manure supplemented with inorganic fertilizers had significant effect on different structural traits in comparison to organic and natural farming in both chilli and garden pea during both the years. Therefore, it implies that integrated use of organic and inorganic fertilizers would be helpful in the manifestation of growth development traits which have direct impact on crop productivity. The judicious use of manures and fertilizers in an integrated way for maintaining the economic crop production and soil fertility on long term basis (Kumari *et al*. 2021).

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