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Study on effect of varying doses of nitrogen and phosphorus on economics of cape gooseberry (*Physalis peruviana* Linn.)

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Abstract
The experiment was carried out at Main Experiment Station Horticulture, Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Faizabad (U.P.) during the year 2015-16 to evaluate the "Effect of varying doses of nitrogen and phosphorus on vegetative growth, fruit yield of cape gooseberry". The experiment was laid out in Factorial Randomized Block Design with twelve treatments comprising of 4 levels of Nitrogen, i.e, (75, 100, 125, 150 kg/ha), and 3 levels of Phosphorus (60, 80, 100 kg/ha) The doses of Nitrogen and Phosphorus were applied in two splits with constant potassium 60 kg/ha. On the basis of experimental finding it is concluded that the application of (N150:P100) kg./ha (T_{12}) was suitable doses for better plant height (112.41 cm), 50 % flowering (105.53 days), Ten fruit weight (95.8 g.), fruit yield/ha (168.10 qt), cultivation cost (80690rs), Gross income 390400rs), Net income 309710rs), and cost benefit ratio (1:3.34) of Cape gooseberry.

Keywords: Crop economics, cape gooseberry and cost benefit ratio, net returns

Introduction

The cape gooseberry is annual and perennial herb, soft wooded erect and somewhat veining shrub. Plants have ribbed, often purplish spreading branches nearly opposite on which, velvety heart shaped pointed leaves of 6-15 cm long and 4-10 cm wide appears regularly along the stem. Fruits are yellow-orange berries, 1 to 3.5 cm in diameter, very juicy aromatic and with a particular bitter-sweet flavour. They are enclosed by the epicalyx, which gives them the shape of a bladder. Yellow pendulous flowers born in leaf axils having companulate hairy corolla's with purple to brown spot. The flowers are self pollinated but the pollination is enhanced by gentle shaking of flowering stems or giving the plants a light spray with water after the flowers falls. The calyx expands, ultimately forming a straw-coloured husk much larger than the fruits encloses. Fruits ripe best when it still attached with plant and berry is globosely, smooth, glossy, orange-yellow skin and juicy pulp containing numerous very small yellowish seeds. As the fruits ripen, they begin to drop on the ground. Generally fruits are harvested manually at frequent interval, which is considered to be most expensive operation in cape gooseberry production.

The cape gooseberry deserves special attention particularly due to its availability in lean period, wide adaptability, quick growing in nature, high productivity, non-perennial occupation of land and delicious fruit with pleasing acetic taste (Prasad *et al*., 1985) [2]. The crop seemed to be widely adapted to varying agro-climatic and soil conditions.

The progressive increase of the demand for food is one of the greatest incentives for farmers to increase and diversify their production, in this context; the orcharding has great contribution in the Brazilian scenario, with the addition of many exotic species (Muniz *et al.*, 2011). The group of small fruits is causing great interest because of the high market value and the low cost of production (Mota, 2006; Rodrigues *et al*., 2009) [3, 4]. The cape gooseberry (*Physalis peruviana* L.) is one of the fruit which is used as the popular medicine, for purification of blood and relief of throat problems (Chaves *et al.,* 2005) [5].

The cape gooseberry is cultivated in moderately cold regions (1800 to 2800 meter from sea level) in Cundinamarca, Boyacá and Antioquia. The production is carried out by small farmers using diverse technologies, and it is grown in small plots, with high participation of family manual labor (Angulo, 2003).

It has grown as annual crop in plains of North India and as perennial crop in hill of Southern region. In North India it can be successfully grown up to an elevation of 1200 m. While in South India it thrives well up to 1800 m.
The plant like sunny, frost free location and sheltered from strong winds. It can thrive in mild cold up to 5 ^{0}C. It is said to succeed wherever tomato can be grown from nutritional point of higher temperature upto 35^{0}C, however, temperature around 21 ^{0}C is ideal for good crop. The cape goose berry can be grown in any well drained soil of neutral pH but it does not best in sandy loam soil having adequate porosity for drainage (Chattopadhyaya, 1996) [1]. Low laying areas with poor drainage is not suitable for this crop. The dates of sowing and plant population per unit area play decisive role with regards to obtain optimum growth of plant and high fruit yield. Successful cultivation of any crop depends upon several factors, sowing date as reported in tomato and sweet pepper.
One of the main research goals is to improve the agro technology of cape gooseberry and to optimize productivity, with the objective to guarantee the quality that is necessary to meet international standards due to its demand in the international markets, it is important to develop research to increase the production and quality in order to reach a more competitive product. Crop simulation models have received attention in the last few years because of their use as research tools and in analysis of decisions on crop management. This work aims is to construct a simple potential production model of cape gooseberry that allows for the estimation of parameters for different phonological stages and for prediction of dry matter production of the crop under non-limiting water and nutrient conditions. Hence there is interest in using this approach to facilitate new research that leads to improved decision making in all the levels of the farming sector (Cantor *et al*., 1995).
The growth and yield of crop is influenced by various factors like climate, soil fertility, growing methods etc. The fertilizer application is of immense importance for soil fertility management and it is more responsible for realizing the higher yield. Nitrogen, phosphorus along with potassium is considered as essential primary nutrient, which are required in large quantities. Nitrogen has been well recognized as important essential element, which imparts better growth and development of plant. It is an integral constituent of proteins, chlorophyll, alkaloids, amides and other compound, and activates the enzymes involved in protein and carbohydrate metabolism. Phosphorus helps in rapid root development facilitating carbohydrate translocation and photosynthesis. Potassium is another important nutrient element, which has key role in respiration, photosynthesis, chlorophyll development and water regulation in plants (Salisbury and Ross, 1995)

Methods and Materials

The experiment was conducted at Main Experiment Station, Department of Horticulture, Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj). Faizabad (U.P) during the period of 2015-2016. The experimental site falls under sub-tropical climatic zone of eastern parts of India, which is situated under Indo-gangetic plains. Faizabaad district comes under eastern region of Uttar Pradesh, The experimental area had a soil sandy loam in texture with good fertility. The experimental was laid out in a factorial randomized lock design with three replications. The plot size was 3.6 m × 3.0 m and Spacing 60cm × 60cm. and total number of treatment combination are 12 consisting of 4 levels of nitrogen *viz.*,N_1 (75 kg N/ha), N_2 (100 kg N/ha) N_3 (125 kg N/ha), N_4 (150 kg N/ha) and 3 levels of phosphorus P_1 (60 kg/ha), P_2 (80 kg/ha), P_3 (100 kg /ha) with a recomended uniform dose of potassium (60 kg/ha) application to all treatments. A recommended doses of FYM was also applied to all treatments uniformly. The straight fertilizer *viz.*, Urea, Single Super Phosphate and Murate of Potash were used as the source of N, $P_2 0_5$ and K_2O respectively. Half dose of nitrogen and full dose of phosphorous and constant dose of potassium as per requirement of respective treatments were applied before transplanting as basal application while, remaining half doses of nitrogen was top dressed after 30 days of transplanting of the seedlings. Estimation of nutrient status in the soil and plant samples was done in the laboratory by adopting the standard procedures established by several research workers. Available organic carbon in the soil (Walkley and Black, 1947), nitrogen content in the soil and plant samples was estimated by Microkjeldahl's method described by Tandon (1993), phosphorous content in the soil and plant samples was estimated by vando molbdo phosphoric acid yellow colour method described by Tandon (1993), potassium content in the soil and plant samples was estimated by flame photometric method described by Jackson (1973).

Results and Discussion

Crop economics

The cost of cultivation for each treatment was worked out by taking in to consideration of all the expenses incurred. The gross income was worked out by multiplying the fruit yield per hectare under various treatments with prevailing selling price during 2015 -16. The net return was calculated by deducting cost of cultivation from the gross income of the respective treatments and the cost benefit ratio was derived using following formula.

$$\text{Cost benefit ratio} = \frac{\text{Net return (Rs.)}}{\text{Total cost of cultivation (Rs.)}}$$

The economics of the crop cultivation under different treatment combination was worked out on the basis of input-output analysis. And thus the results obtained on various components of crop economics have been presented in Table No. 1
The statistical analysis of data (Table-2) revealed that The interaction between nitrogen and phosphorus treatments for Plant height was also found significant in cape goosebeery. The tallest plant (112.41 cm) was measured in N_4P_3 (N125:P100) which was found significantly at par with N_4P_2 (N150:P80) and N_4P_1 (N150:P60) with (110.73 cm) and107.73 cm respectively. The minimum height 74.05 cm was measured in N_1P_1 (N75:P60). The nitrogen and phosphorus application showed significant effect on number of branches/plant and recorded maximum with the application of (N150:P100) kg /ha followed by (N150:P80) kg/ha and minimum in (N 75:P60) kg/ha. The maximum fruit yield per plant was recorded in N_4P_3 (605.21 g) (N150:P80) followed by N_4P_2 (561.53g) (N150:P60). Lowest fruit yield per plant was found in N_1P_1 (218.27g) (N75:P60). The maximum yield of fruit per hectare was recorded in N_4P_3 (168.11 q/ha) which was found at par with N_4P_2 (155.98 q/ha), N_4P_1 (139.36q/ha), N_3P_3 (134.82 q/ha). Lowest yield of fruit q/ ha was found in N_1P_1 (60.62 q/ha). The fruit weight was also increased significant with increasing levels of NPK with the application of (N150:P100) kg/ha followed by (N150:P80) kg NPK/ha and minimum in (N75:P60) kg/ha. It has been observed that N

doses & P doses significantly increased plant height, number of branches and flowering and fruiting characters like number of berry per plant, fruit weight, fruit volume, fruit yield per plant, fruit yield per hectare and days to first flowering and days to 50% flowering was observed late in increasing level of N & P application.

Table 1: Economics of varying doses of nitrogen and phosphorus of Cape gooseberry *(Physalis peruviana* Linn.)

Treatments	Cultivation Cost (Rs.)	Gross income (Rs.)	Net return (Rs.)	Cost benefit ratio
T_1	79460	207600	128140	1:1.60
T_2	79700	208135	128435	1:1.62
T_3	79940	208280	128340	1 : 1.61
T_4	79710	228560	148850	1 : 1.86
T_5	79950	257680	177730	1 : 2.22
T_6	80190	275720	195530	1 : 2.43
T_7	80200	244560	164360	1 : 2.04
T_8	80477	294800	214323	1 : 2.66
T_9	80440	319560	239120	1 : 2.97
T_{10}	80090	263680	183590	1 : 2.29
T_{11}	80290	313520	233230	1 : 2.90
T_{12}	80690	390400	309710	1 : 3.34

1. 1 kg fruit price – Rs. 100/kg
2. Labour charge – 150 Rs/day
3. Urea/kg – 7 Rs/kg
4. Single super phosphate /kg – 10 Rs/kg

Table 2: Effect of Nitrogen, Phosphorus and their interaction on vegetative growth and yield of Cape gooseberry.

Treatments	Plant height (cm)	No, of primary branches	No, of secondary branches	Weight of 10 berry per plant	Fruit yield per plant	Fruit yield per hectare
N_1	77.80	4.44	6.47	69.61	235.86	65.51
N_2	90.11	6.55	8.24	76.68	287.89	79.96
N_3	99.57	9.64	9.54	86.12	371.41	112.69
N_4	110.16	13.31	12.22	94.41	550.69	154.48
SEm±	1.62	0.48	0.16	0.63	8.62	6.40
C.D at 5%	4.74	1.41	0.48	1.86	25.30	18.77
P_1	91.08	12.54	8.35	79.11	331.51	93.21
P_2	94.98	13.13	8.83	81.98	366.14	101.70
P_3	97.18	14.27	10.18	84.02	386.73	114.57
SEm±	1.40	0.41	0.14	0.55	7.47	5.54
C.D at 5%	4.10	1.22	0.41	1.61	21.91	16.25
N_1P_1	74.05	4.27	6.00	66.36	218.27	60.62
N_1P_2	78.52	4.27	6.33	70.73	234.12	65.03
N_1P_3	80.85	4.80	7.07	71.76	255.13	70.88
N_2P_1	85.07	5.53	7.47	73.95	271.41	75.39
N_2P_2	91.25	6.87	8.60	76.76	288.23	80.06
N_2P_3	94,03	7.27	8.67	79.33	304.03	84.45
N_3P_1	97.86	7.60	9.00	83.38	351.05	97.50
N_3P_2	99.43	9.60	9.20	85.81	380.69	105.74
N_3P_3	101.42	11.73	9.54	89.18	382.49	134.82
N_4P_1	107.35	12.54	10.93	92.77	485.33	139.36
N_4P_2	110.73	13.13	11.20	94.63	561.53	155.98
N_4P_3	112.41	14.27	12.12	95.83	605.21	168.11
SEm±	2.80	0.83	0.28	1.10	14.94	11.08
C.D at 5%	8.21	2.45	0.83	3.22	43.83	32.51

N_1 (75 kg N/ha), N_2 (100 kg N/ha) N_3 (125 kg N/ha), N_4(150 kg N/ha) and 3 levels of phosphorus P_1 (60 kg/ha), P_2 (80 kg/ha), P_3 (100 kg /ha)

Economics

The cost of cultivation varied from (Rs. 79460/ha to Rs.80690 /ha). The highest cost of cultivation was calculated under T_{12} (N 150: P 100) treatment and minimum in T_1 (N 75: P 60). The gross income were calculated under different treatment combinations revealed that it was maximum in T_{12} (N 150: P 100) treatment Rs. 390400/ha and minimum in l *i.e.* T_1(N 75: P 60) Rs. 207600/ha. The results showed that the maximum net return was estimated under T_{12} (N 150: P 100) treatment Rs. 309710/ha and minimum net return was estimated under T_1 (N 75: P 60) *i.e.* Rs. 128140/ha. Data pertaining to cost benefit ratio under different treatment combinations presented in Table 1 revealed that the net profit was maximum under the T_{12} (N 150: P 100) i.e 1:3.34 treatment and minimum in T_1 (N75: P60) i.e 1:1.60

Conclusion

As economics point of view, highest net realization of Rs.309710/ha along with benefit cost ratio of 1:3.34 was recorded with the application of T_{12} (N 150: P 100) followed by T_9 (N 125: P 100) with net return Rs. 239120/ha and CBR 1:2.97 and T_{11} (N125: P100) with (Rs. 233230 with cost benefit ratio of 1:2.90). This clearly indicated that T_{12} and T_9 treatments are economically viable for gladiolus cultivation besides T_{11}. On the basis of experimental finding it is concluded that the application of (N150:P100) kg/ha was found best doses for better plant growth, flowering, fruiting and yield of Cape gooseberry. Thus the growing of cape gooseberry with (N150:P100) kg/ha is optimum for higher profit per unit area. The application of (N150:P100) kg/ha can be recommended to the farmers for production of cape gooseberry in eastern U.P condition.

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