

Effect of Nitrogen, Phosphorus and Potassium Levels on Growth and Flower Yield of Pyrethrum (*Chrysanthemum Cinerariaefolium*) Under Western Himalayan Region of Uttarakhand

Prawal Pratap Singh Verma^{1*}, R C Padalia² and V R Singh³

¹CSIR - Central Institute of Medicinal and Aromatic Plants Research Centre, Purara, Post-Gagrigole, Bageshwar, Uttarakhand, India.

²CSIR - Central Institute of Medicinal and Aromatic Plants Research Centre, Pantnagar, P.O. Dairy Farm, Udham Singh Nagar, Uttarakhand, India.

³CSIR - Central Institute of Medicinal and Aromatic Plants, near kukrail picnic spot, PO CIMAP, Lucknow, Uttar Pradesh, India.

*Corresponding author email id: prawalpratapsv@gmail.com

Abstract – The experiment was laid out in factorial RBD with three replications at Central Institute of Medicinal and Aromatic Plant Research Centre Purara, Bageshwar (Uttarakhand) during 2014-15 to 2015-16 with the objectives to effect of nitrogen, phosphorus and potash on plant growth and flower yield of pyrethrum (*Chrysanthemum cinerariaefolium*) under western Himalayan region of Uttarakhand. The treatments were combinations of five levels of nitrogen (0, 60, and 80, 100, 120 kg/ha/year), phosphorus (0, 40, and 80, 100, 120 kg/ha/year), and three levels of potash (0, 40, 60 kg/ha/year). The growth parameters viz., plant diameter, number of flower and flower yield were significantly higher with nitrogen, phosphorus and potash @ 100 kg/ha, 100 kg/ha and 60 kg/ha respectively which were on par with 80 kg/ha, 100 kg/ha and 40 kg/ha respectively.

Keywords – Pyrethrum, Nitrogen, Phosphorus, Potash, Plant Diameter, Number of Flower, Flower Yield.

I. INTRODUCTION

Pyrethrum (*Chrysanthemum cinerariaefolium*), a member of section of the genus *Chrysanthemum*, family Asteraceae is a perennial temperate plant with small white, daisy-like flowers from which natural insecticides can be obtained [1]. It is an economically important crop of the highlands in tropical and sub-tropical regions. It is grown in order to extract pyrethrins which are secondary metabolites with insecticidal activity that accumulate in pyrethrum flowers [2]. Germination of the seeds and vegetative growth require low temperature so it grows well in Kashmir valley, Himachal Pradesh, Nilgiri and Palni hills in south [4]. Traditionally, pyrethrum was produced in many African countries. The first attempt to introduce pyrethrum in India was made by the forest department, Jammu and Kashmir as early as in 1931 [4]. Pyrethrins are natural products, derived from pyrethrum flowers that have been used as an insecticide for over a century [8]. Being non-poisonous to man pyrethrum is particularly adapted for controlling household insects; however, it is also used for preparing horticultural dusts and sprays [5]. The most valuable property of pyrethrum in comparison to other insecticides is its low mammalian toxicity. Because of this quality, pyrethrum is the only insecticide safe for human beings, whereas synthetic insecticides pose a problem of health hazards for human beings, domestic animal and wild life [4]. About 200 years ago someone living in central Asia

discovered that dried, crushed flowers of certain chrysanthemums were toxic to insects. During the Napoleonic Wars (1804-1815) this "insect powder" was used to control flea and body lice infestations by French soldiers [10]. Since then, pyrethrum has been used in many forms for effective, low toxicity insect control. The increased awareness of the dangers of synthetic insecticides and the rapid building up of resistance in the insect population against synthetic insecticides are acting in favored of pyrethrins, which do not show any of these disadvantages. The demand for pyrethrum flowers is therefore, rising rapidly in the world market and India has a very bright future to meet this large increase in demand as pyrethrum can be cultivated successfully in the area like valley of Kashmir and Kumaon (Uttarakhand). Pyrethrum is used as an insecticide in the form of powder, spray, aerosol, coils, cream and ointment [4]-[6]-[9] have investigated that the flower yield of pyrethrum could be improved by applying phosphorus fertilizer whereas nitrogen and potash fertilizer did not increase the yields. [7] Showed that the pyrethrum respond to nitrogen fertilizer on soil deficient in nitrogen. With this view, the present study was under taken to find out optimum level of nitrogen, phosphorus and potash on plant growth and flower yield of pyrethrum (*Chrysanthemum cinerariaefolium*) under western Himalayan region of Uttarakhand.

II. MATERIALS AND METHODS

A field experiment was conducted during the year 2014-15 to 2015-16 at Central Institute of Medicinal and Aromatic Plant Research Centre Purara, Bageshwar (Uttarakhand). The Experimental site is situated at an elevation of 1500-1560 m between the coordinate's 79° 51' 38" East and 29° 38' 45" North in Katyur valley of Uttarakhand hills. The valley remains hot during summer and cold during winter. The monsoon usually breaks in June and continues up to September. Soil sample were analyzed for physical and chemical properties before transplanting are presented in table 2. The climatic conditions during the experiment period are presented in table 3. The treatments compressed of five levels of nitrogen, phosphorus and three level of potash. Details about treatments of the experiments are presented in table 1. Treatments were laid out in factorial RBD with three replications. Planting hole was

dug on plots 225 × 135 meter with a spacing of 45 × 45 cm. All the phosphorus, potash and half of the nitrogen were placed in the planting holes and thoroughly mixed with soil just before planting. The experimental materials for the investigation consisted Hansha genotype of pyrethrum. Seedlings of pyrethrum were kept in the nursery for one month before transplanted in plots on July 2014. The rest of the nitrogen was given in February 2015. Mature stalks were cut back in August 2015 to mark the beginning of second year. All the second year's application of phosphorus and potash and half of the nitrogen were given in the August 2015 and the rest of the nitrogen was applied in February 2016. Weeding was done once in every two months. The first flower flush was collected six months after transplanting, thereafter flower were collected at intervals of 10-15 days through the period of study. The flower were sun dried for 48 hours, then oven dried at 80°C for 2-3 hours followed by oven drying at 50°C to constant weight and the dry weight were recorded.

1.1. Data collection

The data were collected from five randomly selected plants. Each plot on growth and yield characters such as plant diameter (cm), number of flower and flower yield (Kg).

1.2. Statistical Analysis

Data on observed parameters were statically analyzed using ANOVA for factorial RBD and treatment differences were separated using CD at 5% and 1% level of probability.

Table 1. Details of nitrogen, phosphorus and potash experimental treatments.

Treatments	Fertilizer combination
N ₁	0 nitrogen (kg/ha/year)
N ₂	60 nitrogen (kg/ha/year)
N ₃	80 nitrogen (kg/ha/year)
N ₄	100 nitrogen (kg/ha/year)
N ₅	120 nitrogen (kg/ha/year)
P ₁	0 phosphorus (kg/ha/year)
P ₂	40 phosphorus (kg/ha/year)
P ₃	80 phosphorus (kg/ha/year)
P ₄	100 phosphorus (kg/ha/year)
P ₅	120 phosphorus (kg/ha/year)
K ₁	0 potash (kg/ha/year)
K ₂	40 potash (kg/ha/year)
K ₃	60 potash (kg/ha/year)

Table 2. Initial physical and chemical analysis of experimental soils.

Soil parameter	Particulars
Soil type	Sandy loam
Soil pH	6.2
Organic carbon content	0.36 %

Table: 3. Monthly average of climate parameter during the crop growing season.

Climate factor	February	March	April	May	June
Minimum temp. (°C)	28.0	31.0	32.2	39.6	41.0
Maximum temp. (°C)	4.0	5.0	10.2	11.1	14.0
Relative humidity (%)	79.61	68.1	78.0	72.0	62.0
Rain fall (mm)	-	-	-	24	32

III. RESULTS AND DISCUSSION

The mean data on plant diameter (cm), number of flower and flower yield (kg) are presented in table 4, 5 and 6. The pooled data revealed that the increase in nitrogen level from 0 kg/ha to 120 kg/ha increased the plant diameter (cm), number of flower and flower yield (kg) progressively. Level N₄ (100 kg nitrogen/ha) was recorded maximum plant diameter (15.40 cm), maximum number of flower (40.45) and maximum flower yield (287 kg) in pooled data, closely followed by N₃ (80 kg/ha). The nitrogen level of 0 kg/ha (N₁, control) recorded lower plant diameter (14.45 cm), less number of flower (34.25) and less flower yield (260 kg/ha) at harvest in pooled data. Increased in phosphorus levels also increased the plant diameter (cm), number of flower and flower yield (kg) in pooled data, but phosphorus level N₄ (120 kg P/ha) recorded plant diameter (cm), number of flower and flower yield (kg) of 20 cm, 52, 306 kg respectively, which were on par with these parameter recorded with N₅ i.e., 100 kg P/ha (18.86 cm, 48 and 299 kg) in pooled data. Phosphorus results were found better than all other nutrients, it was so because phosphorus is a constituent of protein, enzyme and chlorophyll which might have been helpful in development of better infrastructure of plant through increased with increased level of phosphorus. Similar results are also obtained by B R Rajeshwar Rao et al. [3]. Increase in potash levels also increased the plant diameter (cm), number of flower and flower yield (kg) in pooled data, but potash level on K₃ i.e., 60 kg K/ha recorded higher plant diameter (16.80 cm), higher number of flower (42) and more yield of flower (288.50 kg) followed by potash level on K₃ i.e., 40 kg K/ha (15.65 cm, 37, 280 kg).

The data estimated in table 4, indicate that the interaction effect of nitrogen, phosphorus and potash on plant diameter (cm), number of flower and flower yield (kg) were found significantly maximum plant diameter (20 cm) was obtained significantly with application of 120 kg phosphorus/ha (P₅). The minimum plant diameter (12.95) was obtained in P₁ (control). Maximum number of flower (52) was also found in P₅ (120 P kg/ha) and minimum number of flower (27) was obtained P₁ (0 kg/ha). Pyrethrum flower yield (306 kg) was more in P₅ (120 kg P/ha) as compared to other level of nutrients and minimum flower yield (175 kg) under P₁ (0 kg P/ha).

Table 4. Effect of nitrogen on growth and yield parameter of pyrethrum (*Chrysanthemum cinerariaefolium*).

Treatment	Plant diameter			Number of flower			Flower yield		
	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled
N ₁ (0 kg/ha/year)	12.40	16.50	14.45	24.40	44.10	34.25	160.00	360.00	260.00
N ₂ (60 kg/ha/year)	12.50	16.80	14.65	25.60	54.57	40.08	165.00	390.00	277.50
N ₃ (80 kg/ha/year)	12.20	17.47	14.83	25.20	54.20	39.70	179.00	392.00	285.50
N ₄ (100 kg/ha/year)	12.60	18.20	15.40	25.70	55.20	40.45	180.00	394.00	287.00
N ₅ (120 kg/ha/year)	11.80	16.50	14.15	24.73	52.10	38.41	176.00	370.00	273.00
Gen. Mean	12.30	17.09	14.69	25.12	52.0	38.58	172.00	381.20	276.60

Treatment	Plant diameter			Number of flower			Flower yield		
	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled
C.V.	9.827	5.521	7.206	3.864	2.025	2.491	0.596	0.249	0.379
F Prob.	0.928	0.219	0.357	0.466	0.000	0.000	0.000	0.000	0.000
S.E.M.	0.698	0.545	0.432	0.561	0.608	0.392	0.592	0.548	0.428
C.D. 5%					1.984	1.166	1.929	1.786	1.272
C.D. 1%					2.887	1.597	2.807	2.599	1.743

Table 5. Effect of phosphorus on growth and yield parameter of pyrethrum (*Chrysanthemum cinerariaefolium*).

Treatments	Plant diameter			Number of flower			Flower yield		
	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled
P ₁ (0 kg/ha/year)	10.70	15.20	12.95	18.00	36.00	27.00	100.00	250.00	175.00
P ₂ (40 kg/ha/year)	13.20	17.30	15.25	30.00	42.00	36.00	175.00	280.00	227.50
P ₃ (80 kg/ha/year)	15.30	17.40	16.35	37.00	48.00	42.50	180.00	360.00	270.00
P ₄ (100 kg/ha/year)	17.40	20.33	18.86	40.00	56.00	48.00	188.00	410.00	299.00
P ₅ (120 kg/ha/year)	18.20	21.80	20.00	46.00	58.00	52.00	190.00	422.00	306.00
Gen. Mean	14.90	18.406	16.68	34.20	48.00	41.10	166.60	344.40	255.50
C.V.	3.661	5.735	6.026	3.269	2.135	2.513	0.329	0.305	0.38
F Prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
S.E.M.	0.316	0.609	0.410	0.645	0.592	0.422	0.316	0.606	0.40
C.D. 5%	1.031	1.988	1.219	2.105	1.929	1.253	1.031	1.975	1.19
C.D. 1%	1.500	2.892	1.671	3.063	2.807	1.716	1.501	2.873	1.63

Table 6. Effect of potash on growth and yield parameter of pyrethrum (*Chrysanthemum cinerariaefolium*).

Treatment	Plant Diameter			Number of Flower			Flower Yield		
	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled
K ₁ (0 kg/ha/year)	10.80	15.40	13.10	22.00	42.00	32.00	171.00	350.00	260.50
K ₂ (40 kg/ha/year)	12.60	18.70	15.65	26.00	48.00	37.00	180.00	380.00	280.00
K ₃ (60 kg/ha/year)	13.40	20.20	16.80	32.00	52.00	42.00	182.00	395.00	288.50
Gen. Mean	12.26	18.10	15.18	26.66	47.33	37.00	177.66	375.00	276.33
C.V.	5.113	3.093	7.065	0.000	1.220	2.791	0.325	0.154	0.356
F Prob.	0.017	0.001	0.000	0.009	0.000	0.000	0.000	0.000	0.000
S.E.M.	0.362	0.323	0.438	0.000	0.333	0.422	0.333	0.333	0.401
C.D. 5%	1.422	1.269	1.380	0.000	1.309	1.329	1.309	1.309	1.265
C.D. 1%	2.358	2.104	1.963	0.000	2.170	1.890	2.170	2.170	1.799

IV. CONCLUSIONS

Plant nutritional status affects yield and quality of produce. Hence it is essential to have a good knowledge of the plant's nutrients requirements to ensure a good yield and to avoid nutrient wastage, which will decrease production costs and reduce the risk of water pollution. This study concluded that nitrogen level of 100 kg/ha (N₄), phosphorus

level of 120 kg/ha (P₅) and potassium level of 60 kg/ha (K₃) was found best in pooled data. Nitrogen, phosphorus and potash in ratio of 100: 120: 60 produced maximum plant diameter (cm), number of flower and flower yield (kg) of pyrethrum. It can be concluded that application of NPK @ 100 + 120 + 60 kg/ha improved the growth of plant and flower yield of pyrethrum under western Himalayan region of Uttarakhand.



Plate A and B: Plot view of treatment N₄ (100 kg/ha/year) on growth and yield parameter of pyrethrum (*Chrysanthemum cinerariaefolium*).

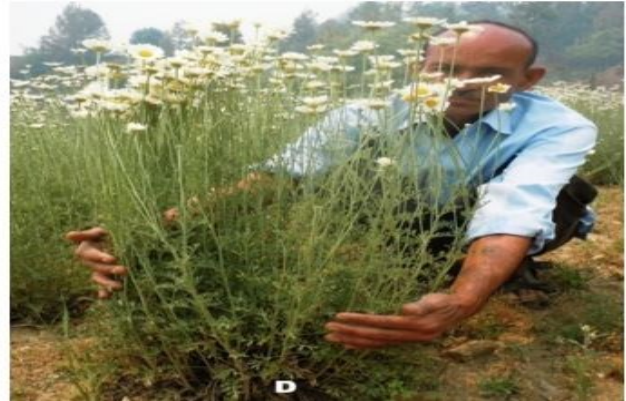


Plate C and D: Plot view of treatment P₅ (120 kg/ha/year) on growth and yield parameter of pyrethrum (*Chrysanthemum cinerariaefolium*).



Plate E and F: Plot view of treatment K₃ (60 kg/ha/year) on growth and yield parameter of pyrethrum (*Chrysanthemum cinerariaefolium*).

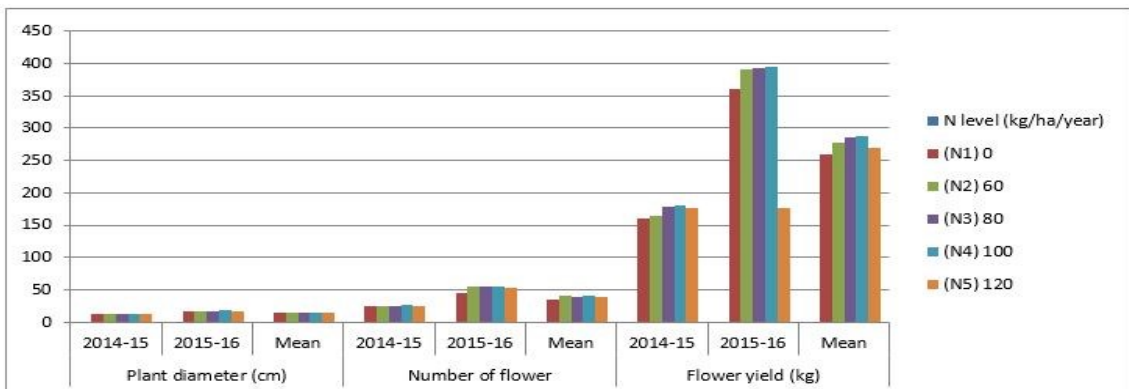


Fig. 1. Effect of nitrogen on growth and yield parameter of pyrethrum (*Chrysanthemum cinerariaefolium*)

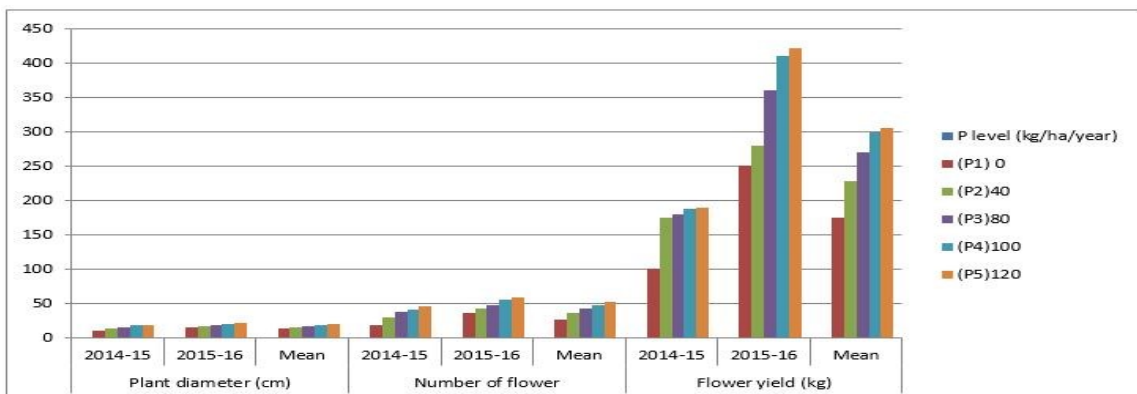


Fig. 2. Effect of phosphorus on growth and yield parameter of pyrethrum (*Chrysanthemum cinerariaefolium*)

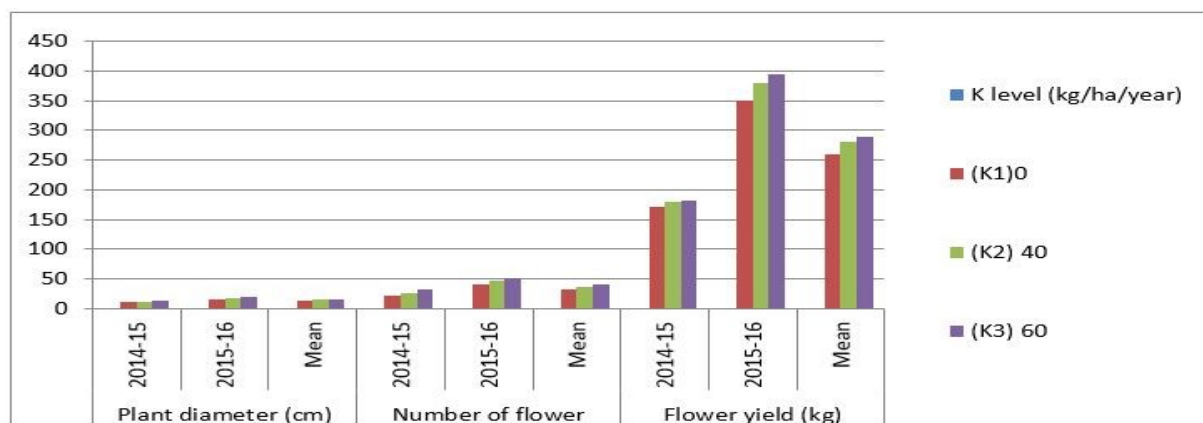


Fig. 3. Effect of potash on growth and yield parameter of pyrethrum (*Chrysanthemum cinerariaefolium*)

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AUTHORS' PROFILES



Mr. Prawal Pratap Singh Verma is working as a technical Assistant Agriculture in CSIR-Central Institute of Medicinal and Aromatic Plant and present time posted at Regional Research Centre Purara, Bageshwar Uttarakhand, India. He gained over 4 years of experience in agro-technology development work on MAPs. An esteemed academician having the conferences as well as publishing of many articles and papers. The major areas of research including crop improvement, crop production and protection, plant multiplication, processing of the plant and distillation processes. Expertise has been gained in the field of Medicinal & Aromatic Plants etc., through research and training program.



Dr. R.C. Padalia is the senior scientist at CSIR-Central Institute of Medicinal and Aromatic Plants Research Centre, Pantnagar, P.O. Dairy Farm, Udham Singh Nagar, Uttarakhand, India. Experience of working with non-polar and polar capillary columns for flavor components. Good skill of interpretation of mass spectra and identification of volatile compounds. Essential oils & Aroma Chemicals, R & D on Quality evaluation of essential oils, aroma compounds and their value addition, Isolation, Characterization and chemical modification of bioactive compounds by Chromatography and other separation techniques and by Molecular Spectroscopy; Developing bioactive marker constituents in MAPs; R & D on Quality evaluation, Agro-technology and Post-Harvest technologies of aromatic plants; Chemistry of Natural Products.



Dr. V. R. Singh is the scientist-In-Charge in CSIR-Central Institute of Medicinal and Aromatic Plants Research Centre, Pantnagar, P.O. Dairy Farm, Udham Singh Nagar, Uttarakhand, India. An eminent scientist having gained rich experience in managing collaborative and independent research functions. An esteemed academician having the distinction of being associated with numerous scientific seminars, presentations, workshops, talk invitations, conferences as well as publishing of a plethora of articles & Papers. He Possesses expertise knowledge in genetic improvement of medicinal and aromatic crops deploying Plant Breeding approaches, genetic improvement of Medicinal and Aromatic plants through breeding (Conventional and Classical Breeding) approaches and collection, maintenance, evaluation and multiplication of germplasm of selected MAPs Crops.