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Effect of integrated nutrient management on vegetative growth and economics of German chamomile (*Matricaria chamomilla* L.)

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Abstract
The present investigation entitled "Effect of Integrated Nutrient Management in German chamomile (*Matricaria chamomilla* L.)" was conducted at Main Experiment Station, Department of Horticulture, Narendra Deva University of Agriculture & Technology, Narendra Nagar (Kumarganj), Faizabad (U.P.) during two consecutive years 2015-16 and 2016-17. The experimental material i.e. German chamomile. The experiment was laid out in randomized block design with seventeen treatments comprising of PSB, Azotobacter and FYM alone or in combination with each other and variable doses of N, P and K in three replications.

Among the treatments applied in the present study, maximum plant height at bud initiation, plant height at flowering stage and plant height at harvest stage (59.10, 58.40 and 61.50 cm in 2015-16 and 60.85, 62.80 and 63.30 cm in 2016-17) was recorded in plants treated with 50% RDF + 5.0 kg Azotobactor + 5.0 kg PSB/ha (T_{17}) followed by T_1 (RDF (N:P:K-60:40:30kg/ha) and T_{16} (50% RDF + 2.5 kg Azotobactor + 2.5kg PSB/ha) which exhibited significant increase over other treatments during both the years of study. The maximum net return (Rs. 131341) was found under treatment combination 50% RDF + 5.0 kg Azotobactor + 5.0 kg PSB/ha (T_{17}) followed by other treatment combinations. This is due to higher production of dry flowers yield and gave maximum Benefit: cost ratio *i.e.* 2.09.

Keywords: foliar application, physiological attributes, salicylic acid, yield

Introduction
Chamomile (*Matricaria chamomilla* L.) is a well-known aromatic plant species from the Asteraceae family often referred to as the "star among aromatic species." Now a days, it is a highly favoured and much used aromatic plant in folk and traditional medicine. It's multi-therapeutic, cosmetic, and nutritional values have been established. Through traditional and scientific use and research. Chamomile had an established domestic (Indian) and international market, which is increasing day by day. The plant available in the market many a times is adulterated and substituted by close relatives of chamomile. It is one of the important aromatic herb native to southern and eastern Europe. It is also grown in Germany, Hungary, France, Russia, and Brazil. It was introduced in India during the Mughal period, now it is grown in Punjab, Uttar Pradesh, Maharashtra and Jammu and Kashmir. The plants are also found in North Africa, Asia, North and South America, Australia, and New Zealand. Hungary is the main producer of the plant biomass.

In India, this plant had been cultivated in vast area. Due to varied agro-climatic condition, it can be commercial cultivated in different part of India successfully. It was introduced in Jammu in 1957 by Handa *et al*. (1957) [5]. The plant was first introduced in alkaline soils of Lucknow in 1968 by Chandra *et al*. (1968) [1]. Presently, 2 firms, namely, M/s Ranbaxy Labs Limited, New Delhi and M/s German Remedies are the main growers and buyer of chamomile of its flowers.

True chamomile is an annual plant with thin spindle-shaped roots only penetrating flatly into the soil. The branched stem is erect, heavily ramified, and grows to a height of 10-80 cm. The long and narrow leaves are bi- to tripinnate. The flower heads are placed separately, they have a diameter of 10-30 mm and they are pedunculate and heterogamous. The golden yellow tubular florets with 5 teeth are 1.5-2.5 mm long, ending always in a glandulous tube. The 11-27 white plant flowers are 6-11 mm long, 3.5 mm wide, and arrange d concentrically. The receptacle is 6- 8 mm wide, flat in the beginning and conical, cone-shaped later, hollow-the latter being a very important distinctive characteristic of *Matricaria*-and without paleae.

The fruit is a yellowish brown achene. Essential oils and aroma chemicals are indispensable in various human activities. They are adjuncts of cosmetics, soaps, pharmaceutical preparation, perfumer confectionery, ice-cream, aerated waters, disinfectants, agarbatti etc.

Materials and Methods

The present investigation entitled "Effect Effect of Integrated Nutrient Management in German chamomile (*Matricaria chamomilla* L.) was carried out at Main Experiment Station, Department of Horticulture, Narendra Deva University of Agriculture & Technology, Kumarganj, Faizabad, (U.P.) during the year 2015-16 to 2016-17. The experiment was laid out in randomized block design with seventeen treatments comprising of PSB, azotobacter, vermicompost, poultry manure and FYM alone or in combination with each other and variable doses of N, P, K in three replications.

The observations with respect to plant height at bud initiation stage, plant height at flowering stage, plant height at harvest stage and economics were recorded during both cropping years i.e. 2015-16 and 2016-17.

Results and Discussion

Vegetative Growth

The observation recorded pertaining to various plant growth characteristics, mainly on plant height, number of primary and secondary branches per plant and total biomass production as influenced by different levels of nitrogen, clearly indicated that there was significant increasing trend in plant height and number of primary branches and secondary branches due to increasing levels of nitrogen. However, maximum height at bud initiation of the plant (60.85 cm), plant height at flowering stage (62.80 cm) and plant height of final harvesting (63.30) was recorded at highest dose of T_{17} (50% RDF + 5.0 kg Azotobactor + 5.0 kg PSB/ha) as compared to lower doses of nitrogen. It is evident from the results that the development of more number of foliage has significant relation to nitrogen fertilization. The balanced supply of nitrogen in relation to improving the growth behaviours of plant have been demonstrated by number of earlier workers in chamomile and other aromatic crops. Meawad *et al*., (1984) [8], Emonger *et al*., (1989) [2], Johri *et al*., (1994), Gowda *et al.,* (1991) [4] and Kanjilal and Singh (2000) [6]. The increase in different plant growth characteristics *viz.* plant height due to increasing levels of nitrogen a may also be explained on the basis of nitrogen-carbohydrate balance theory and more uptake of nutrients from the upper layers of soil surface by growing of shallow rooted and most tolerant species in salt-affected soils by supplementing the higher doses of nitrogen (Table 1).

The data recorded on plant spread (cm^2) due the effects of different treatments indicated that the plant spread is important growth parameters for improving the flower yield in Matricaria. It is evident from the observations recorded that the maximum average number of plant spread (28.25 cm^2) was recorded in treatment of 50% RDF + 5.0 kg Azotobactor + 5.0 kg PSB/ha (T_{17}). Kumar and Singh (2007) [7].

Economics

The maximum net return (Rs. 131341) was found under treatment combination 50% RDF + 5.0 kg Azotobactor + 5.0 kg PSB/ha (T_{17}) followed by other treatment combinations. This is due to higher production of dry flowers yield and gave maximum Benefit: cost ratio *i.e.* 2.09. (Godse *et al*., 2006) [3].

Table 1: Effect of INM on vegetative growth and economics.

Treatment	Plant height at bud initiation		Plant height at flowering stage		Plant height at final harvest stage		Plants spread (cm^2)		Economics	
	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
T_1- RDF (Control)	57.60	59.30	59.40	61.20	59.90	61.70	27.00	27.55	121177	126677
T_2- Azotobactor 2.5 kg/ha	44.90	46.20	46.30	47.65	46.70	48.10	21.05	21.45	81747	85997
T_3- Azotobactor 5.0 kg/ha	46.45	47.80	47.85	49.30	48.20	49.65	21.75	22.20	86247	90747
T_4- PSB 2.5 kg/ha	44.40	45.70	45.75	47.10	46.20	47.60	20.80	21.22	79997	84247
T_5- PSB 5.0 kg/ha	45.90	47.25	47.35	48.75	47.80	49.25	21.50	21.93	84747	88997
T_6 – 25%RDF + 2.5 kg Azotobactor /ha	48.00	49.40	49.45	50.95	49.90	51.40	22.45	22.90	91169	95669
T_7- 25%RDF + 5.0kg Azotobactor /ha	50.00	51.50	51.55	53.10	52.00	53.55	23.42	23.90	97419	102169
T_8- 25% RDF+ 2.5 kg PSB/ha	46.95	48.35	48.40	49.80	48.80	50.25	22.00	22.45	87919	92419
T_9- 25% RDF + 5.0 kg PSB/ ha	49.00	50.45	50.50	52.00	51.00	52.50	22.95	23.40	94169	98919
T_{10}- 25%RDF+2.5kg Azotobactor+ 2.5kg PSB/ha	50.50	52.00	52.10	53.65	52.60	54.20	23.65	24.10	99069	103919
T_{11}-25%RDF+5.0kg Azotobactor +5.0kg PSB/ha	52.00	53.55	53.65	55.25	54.10	55.70	24.40	24.88	103419	108169
T_{12}- 50% RDF + 2.5 kg Azotobactor/ha	53.50	55.00	55.25	56.90	55.80	57.45	25.10	25.60	108841	114091
T_{13}- 50%RDF+5.0 kg azotobactor/ha	55.60	57.25	57.35	59.10	57.90	59.65	26.05	26.55	114841	120091
T_{14}-50% RDF +2.5kg PSB/ha	52.60	54.10	54.20	55.80	54.70	56.35	24.60	25.10	105341	110341
T_{15}-50% RDF +5.0kg PSB	54.10	55.70	55.75	57.40	56.30	58.00	25.35	25.85	110091	115341
T_{16}- 50%RDF+2.5kg Azotobactor+ 2.5kg PSB/ha	56.65	58.35	58.40	60.10	58.90	60.65	26.50	27.05	118091	123341
T_{17}-50%RDF+5.0kg Azotobactor +5.0kg PSB/ha	59.10	60.85	61.00	62.80	61.50	63.30	27.70	28.25	125841	131341
SEm±	2.311	2.35	2.139	2.10	2.373	2.47	0.942	0.98	-	-
CD at 5%	6.658	6.78	6.162	6.06	6.837	7.12	2.714	2.82	-	-

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