Original Research Article

Effectof~~different~~OrganicSourcesofNutrientsonGrowth and Floweringof SprayChrysanthemum

ABSTRACT

Aims: Chrysanthemum(*Dendranthemagrandiflora*Tzvelev)alsoknownas"QueenoftheEast" is one of the most imperative and the oldest flowering plant which is grown all overthe world. Organicmanuresandbio-fertilizersimprovesoilhealthbyincreasingsoilmicroorganisms and it helps to uptake of nutrients easily when crop required by making it unavailableform toavailableform. The present study was conducted to identify the best organic sources of nutrients for quality flowerproductionof Chrysanthemum var. Aparajita.

Experimental Design: TheexperimentwaslaidoutinRCBD(RandomizedCompletelyBlockDesign) where treatments comprised with control and application of enrichedFYM,enrichedVermicompost,enrichedpoultry manures as well as spraying with seaweeds extractsingly and/or in combination as per the treatment.

Place and Duration of the experiment: The present investigation was carried out at Instructional Farm, Department of Floriculture, Medicinal and Aromatic Plants in Uttar Banga Krishi Viswavidyalaya in the year of 2018-2020. The place is situated in Terai Region of West Bengal at 26^0 19 N latitude and 89^0 23 E longitude.

Results: TheresultsrevealedthatapplicationofenrichedFYM@12.5t/ha+enriched vermicompost @ 2.5t/ha + Seaweeds extract spraying @ 3 ml/l (T_{11}) recorded maximumplant height (46.19 cm), plant spread (E-W: 26.54 cmand N-S: 26.72 cm),production ofmore number of primary branches (7.25) and leaves per plant (105.33), minimum days taken to first flower bud initiation(68.13 days) and first flower fullblooming (10.11 days),more number offlowers per plant (35.16), vase life (14.55 days) in tap water,maximum Gross return (Rs. 517957.00 per ha) and B:C ratio (1:2.53) while minimum was recorded in control (T_1) as compare to other treatments.

Conclusion: Based on the experiment itmay be recommended that application of enrichedFYM@12.5t/ha+enriched vermicompost @ 2.5t/ha + Seaweeds extract spraying @ 3 ml/l was best for organic cultivation of spray Chrysanthemum in the Terai region ofWestBengalwhichwasalsoeconomicallyviableforpoorandmarginalfarmers ofWestBengal.

Keywords:*Enrichedorganicmanures,seaweedsextract, spray Chrysanthemum*

1. INTRODUCTION

Chrysanthemum is one of the most imperative and the oldest flowering plant which is grown all overthe world. It has wide range of shapes, sizes and colourof flowers and having long lasting floretsthat'swhyitispreferred.Chrysanthemum(*Dendranthemagrandiflora*Tzvelev)alsoknownas"QueenoftheEast" [1]andbelongstothefamilyAsteraceae.Aftertheindustrialandgreen revolution, use of inorganic fertilizers have been increased which leads to a decline in the usageof organic fertilizers. Chemical fertilizers have an important role in increasing agricultural yield by 50-60%, but their continuous usage not only harms soil health and the environment, but also diminishes crop output [2].Withtheincreaseinpopulations, aim should not be stabilizing the production but also enhance it in a sustainable manner.Therefore, now a day, attention is shifted towards the alternate sources of fertilizers *i.e.* organicsources of nutrients and bio-fertilizers. Organic manures are easily available and the cost is less thaninorganicfertilizers.Organicmanuresandbio-fertilizersimprovesoilhealthbyincreasingsoilmicroorganisms and it helps to uptake of nutrients easily when crop required by making it unavailableform toavailableform [3].InmodernFloriculture,newtechniques have been developed to obtain good quality bloom with sufficient quantity. One amongsuch approachesisthe usage of "bio-stimulants" which have beenemerged as a supplementtomineral fertilizer and improved the yield as well as quality of blooms [4,5].Now a days, the use of enriched organic sources of nutrients occupied an important place as theyprovide a scope for reduction in use of chemical fertilizers which can pollute the soil if long term used [6]. Bio-fertilizers are low cost and renewable organic sources of plant nutrients thatensure slow release of nutrientthroughoutthe cropgrowth period and also used to supplementchemicalfertilizers[7].Use ofbio-fertilizersreducesperunitrequirementofchemical fertilizersand improvesquality aswell as quantityofthe blooms[8].It has been reported that vegetative growth of China aster was increased due to increasing level ofvermi-compost [9]. With the addition of bio-fertilizer to the growing media,duration of flowering in gladiolus, number of florets per spike, size of floret and vase life improved[10]. In dahlia, maximum plant height, number of primary brunches, number of leavesper plant, plant spread, more number of flower are obtained due to the use of enriched vermicompost [11]. Many researchers emphasized the beneficial impacts of organic fertilizers on growth and flower production in China aster [12-13]. Enriched Vermi-compost, an organic fertilizer contains N, P, K, micronutrientsand beneficial soil microbes (nitrogen fixing and phosphate solubilizing bacteria and actinomycetes),and alternative to chemical fertilizers, which is also act as a growth promoter and protector of[14, 15, 16].Maximum grain yield ofmaize obtained by theapplication of enriched FYM [17]. It has been reported that vegetative growth andfruityieldwasincreasedduetotheapplicationofenrichedvermi-compostandpoultrymanure[17]. Sea weed manures rich in potassium [18] and extracts containgrowth promotinghormones (IBA, IAA, Cytokinin), trace elements (Fe, Cu, Zn, Co, Mo, Mn, Ni),vitamins antibiotics and amino acid [19, 20, 21].InChinaasterflowerquality,shelflifeandvaselifewererecordedmaximumbytheapplication of bio-vita @ 1% [22]. In Chrysanthemum, maximum number of leaves,leaf area perplants, number of primary and secondary

brunches was recorded by the application ofbio-vita @ 0.6% [23]. Keeping in view the importance of organic manures and bio-stimulants,thepresentstudywasundertakentofindouttheeffectoforganicmanureandbio-inoculants on vegetative and flowering parameter of spray Chrysanthemum under open field conditioninTerairegionofWestBengal.

2. MATERIALS AND METHODS

2.1 EXPERIMENTAL SITE

ThepresentinvestigationwascarriedoutatInstructionalFarm,DepartmentofFloriculture,Medicinal and AromaticPlantsinUttarBangaKrishi Viswavidyalaya.The place is situated in Terai Region of West Bengal at 26^0 19 N latitude and 89^0 23 E longitude. The sites lie in the sub-Himalayan plains at an elevation of 43 meters above mean sea level. This zone is marked by a typical sub-tropical climate with high relative humidity, moderate temperature, high annual rainfall (3000 mm) and prominent winter.

2.2 EXPERIMENTAL TREATMENTS

Forthisexperiment a chrysanthemum variety named Aparajita was taken, which was a spray floweringchrysanthemum. The treatments were T_1- control, T_2- Enriched Farm Yard Manures (FYM) @ 25ton/ha, T_3-Enriched Vermi-compost @ 5ton/ha, T_4- Enriched Poultry Manure @ 5ton/ha, T_5- Enriched FYM@ 12.5ton/ha+ Enriched Vermi-compost @ 2.5ton/ha, T_6- Enriched FYM @ 12.5ton/ha+ Enriched Poultry Manure @ 2.5ton/ha, T_7- Enriched Vermi-compost @ 2.5ton/ha+ Enriched Poultry Manure@ 2.5ton/ha, T_8-Enrich Vermi-compost @ 2.5ton/ha+ Sea weeds extract @ 3ml/l /foliarspray, T_9- Enriched Poultry Manure @ 2.5ton/ha + Sea weeds extract @ 3ml/l/foliar spray,T_{10}-Enriched FYM @ 12.5ton/ha + Enriched Vermi-compost @ 2.5ton/ha + Enriched Poultry Manure@ 2.5ton/ha, T_{11}- Enriched FYM @ 12.5ton/ha + Enriched Vermi-compost @ 2.5ton/ha+Seaweedsextract@3ml/l/foliarspray,T_{12}-EnrichedVermi-compost@2.5ton/ha+EnrichedPoultry Manure @ 2.5ton/ha + Sea weeds extract @ 3ml/l/foliar spray, T_{13}- Enriched FYM @12.5ton/ha+ Enriched Poultry Manure @2.5ton/ha + Seaweedsextract @3ml/l/foliarspray,T_{14}- Enriched FYM @ 12.5ton/ha + Enriched Vermi-compost @ 2.5ton/ha + Enriched PoultryManure @ 2.5ton/ha + Sea weeds extract @ 3ml/l/foliar spray.

2.3 PLANTING

One-month old rooted cuttingswere transplanted at a spacing of 40 cm x 30 cm with 25 plants in each plot. Enriched organicmanures were applied in two equal splits. First dose was applied @ ½ of the total doses as basal at20 days before transplanting and rest 1/2 was divided in two equal splits doses and applied astopdressing viz. 30 and 60 days after transplanting. The soil of the experimental field was sandy loamwith poor water holding capacity and poor fertility status. Soil has high residual moisture contentand pH was

acidic in nature (5.61). Observations on growth, flowering and postharvest attributeswere recorded. The experimental data was subjected to analysis of variance and critical differencewas calculated to compare the means by following complete randomized design [24].

2.4 STATISTICAL ANALYSIS

The experiment was laid out in RCBD (Randomized Completely Block Design) with threereplications and fourteen treatments during the cropping season from September 2019 to February2020. ~~Statistical analysis was done in OP STAT software~~.

3. RESULTS AND DISCUSSION

TheresultspresentedintheTable-1revealedthattheapplicationofenrichedFYM@12.5t/ha+enrichedvermicompost@2.5t/ha+Seaweedsextracts @3ml/l (T_{11})recorded maximum plant height (46.19 cm), maximum plant spread (E-W: 26.54& N-S: 26.72 cm), no. ofprimary branches per plant (7.25), no. of secondary branches per plant (9.00), no. of leaves perplant (105.33) followed by $T_3$and T_2while maximum leaf area was recorded in T_3(17.25 cm^2).This might be due to the application of enriched organic manures along with biostimulants.Enriched FYM, enriched vermi-compost along with Sea weeds Extract could have accelerate thenitrogenmineralizationprocessthatensuredslowbutsteadyreleaseofessentialnutrientsthroughout the crop growth period and promoted higher plant height and plant spread at the time offlowering. Similar results were reported by Verma et al. [25] in Chrysanthemum.The greaternumber of branches produced per plant might be due to slow but steady release of essential microand macro nutrients and growth promoting substances to the plant throughout the growth period.There by itmightbe favoured forproduction andstimulationofauxiliary budsresultinginformation of higher number of branches per plant. These results were supported by Kale et al.[26] in Salvia and Nethra[27] in China aster. Maximum no. of leaves per plant and leaf areawere produced might be due to application of organic manures in combination with bio-fertilizersand bio-stimulants would have ensured balance nutrients in an optimum level that helped in plantmetabolism through the slow but steady supply of micro nutrients, which encouraged vigorousplant growth and in enriched vermicompost the growth promoting substances present in bio-fertilizer might have enhanced the plant growth and helped to fixing the atmospheric nitrogen andmobilizing the soil phosphorous content. All these mighthave helped in production ofa greaternumber of leaves and higher leaf area. These results were supported by Saha [28] inLettuce,Kumaret al. [29]inAfricanmarigoldandNaik [30]incarnation.

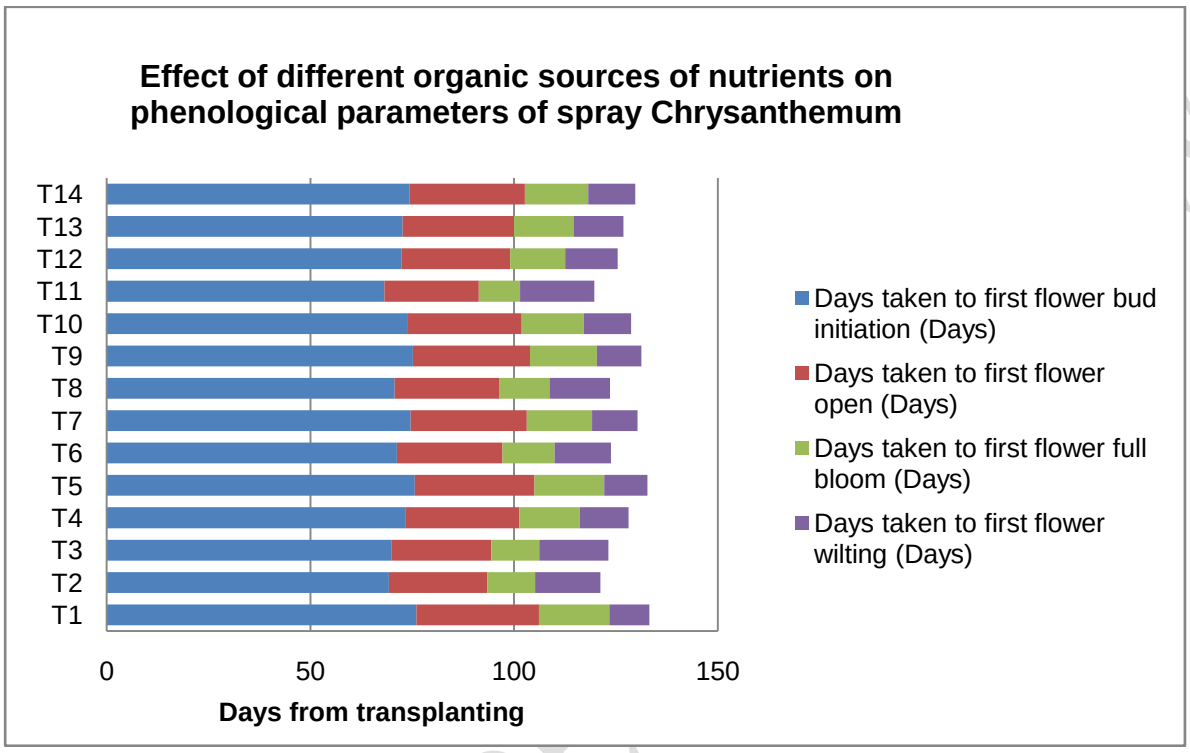
Table 1. Effect of ~~different~~ organic sources ~~of nutrients~~ on growth attributes of spray Chrysanthemum

Treatments	Plant height 30DAP (cm)	Plantheightat the time offlowering (cm)	Plant spread 30DAP (cm)		Plant spread atflowering (cm)		Number ofprimarybranchesperplant	Number ofsecondarybranchesperplant	Number ofleaves at thetime offlowering	Leaf area (cm^2) at the time offlowering
			E-W	N-S	E-W	N-S				
T_1	5.70	27.34	3.54	3.63	13.54	12.65	4.08	4.16	59.41	7.76
T_2	12.64	42.44	7.77	8.13	24.80	24.30	6.66	7.16	96.50	13.53
T_3	12.77	43.60	9.81	9.52	24.84	25.18	6.83	7.58	101.33	17.25
T_4	7.66	33.25	5.81	5.93	21.79	20.96	5.83	6.50	73.25	9.87
T_5	6.72	30.54	4.50	3.84	16.15	14.59	4.91	5.50	68.75	8.78
T_6	10.54	39.63	7.52	7.67	23.41	22.39	6.25	6.41	88.41	11.84
T_7	7.12	30.94	5.70	6.48	19.89	17.33	4.75	5.31	65.66	8.61
T_8	11.90	41.47	8.50	8.12	24.02	22.58	6.50	7.08	92.91	12.91
T_9	6.57	28.69	3.95	3.85	14.18	15.10	4.25	4.41	61.16	8.38
T_{10}	9.00	36.44	6.77	6.62	22.34	20.98	5.33	5.75	77.75	10.45
T_{11}	14.74	46.19	10.69	9.72	26.54	26.72	7.25	9.00	105.33	15.91
T_{12}	9.59	38.40	6.62	7.06	21.30	22.68	6.08	6.33	84.25	10.80
T_{13}	8.66	38.15	6.79	6.67	20.77	22.70	5.83	6.33	82.83	10.69
T_{14}	7.38	32.06	5.58	5.71	19.67	20.34	5.00	5.50	71.66	9.29
Mean	9.35	36.36	6.68	6.63	20.94	20.61	5.68	6.21	80.65	11.15
CDat 5%	1.39	4.86	1.13	1.14	2.55	2.81	1.86	1.63	3.54	0.89
SE(m)±	0.47	1.66	0.38	0.39	0.87	0.96	0.63	0.55	1.21	0.30
SE(d)	0.67	2.35	0.54	0.55	1.23	1.36	0.90	0.78	1.71	0.43
C.V.	8.81	7.92	10.04	10.24	7.23	8.08	19.46	15.54	2.60	4.76

The results of phenological parameters, graphically represented in the Fig.-1, revealed thatapplication of enriched FYM @12.5t/ha+ enriched vermicompost @ 2.5t/ha + Seaweeds extracts @ 3ml/l (T_{11}) recorded minimum days taken to first flower bud open (23.22 days), days taken to firstflower full blooming (10.11 days), maximum days taken to first flower wilting (18.22 days) followedby $T_3$and T_2. The results revealed that early bud initiation, flower opening, full blooming and delay inwilting might be due to the effect of enriched vermi-compost along with FYM and Seaweeds extractcontaining enzymes like amylase,lipase,cellulose which continue to release the essential nutrientsand make it available for root absorption. They also helped to increase some soil enzymes like Urease,dehydrogenase, alkaline phosphate. Urease helps in N- cycle because it hydrolyses urea and enzymephosphate convert soil phosphorous into bio-available form for plants absorption. These results mightalso be due to the gibberellins acid present in vermi-compost which associated with the regulation offlowering. These findings were strongly agreed with works of Vetalet al.[31] in lillium, Yagi et al.[32] in zinnia. *Azotobacter* and PSB might have indirect role which make the nutrient readilyavailable throughout the growth period and along with growth promoting substances which associatedwith the regulation of flowering. These findings are in corroboration with the work Naik et al.

[33]inmarigoldandKhannaet al.[34] inChinaaster.

Fig. 1. Effect of ~~different~~ organic sources of ~~nutrients~~ on phenological parameters of spray Chrysanthemum.



*0 days means transplanting day of the seedlings.

Treatment T_{11}recorded more no. of flowers per plant (35.16), no. of flowers per plot(879.16), Vase life (14.55 days), field life (16.10 days) while minimum was recorded in treatment T_1as compare to other treatments. Treatment T_3(enriched vermicompost @ 5t/ha) recorded maximumleaf area (17.25 cm^2), stalk length (6.46 cm), flower weight (1.12 g), flower diameter (3.36 cm) ascompare to other treatments presented in the Table-2. The treatment T_{11}produced more. No. of flower perplant and more no. of flowers per plot might be due to the combined application of enriched manuresalongwithbio-stimulants.Plantgrowthpromotingsubstancespresentinbio-fertilizerlikegibberellins,IAA,vitamin,riboflavinsmighthaveenhancedthesoilfertilitybyincreasingtheavailability of plant nutrients. Combined application of bio-fertilizers and organic manures might haveenhanced root and shoot development, thereafter it might have influenced the reproductive phase andinduced flowering which finally resulted in a greater number of flowers per plant and per plot. Similarfindings were reported by Thumaret al. [35], Patel et al. [36] in Marigold and Airadevi andMathad [37] in garland Chrysanthemum.Increased flower diameter might be due to the effect of vermi-compostalong with bio-fertilizer.PSB has the ability to bring insoluble phosphate into soluble formby releasing organic acid which can also helps to improve flower diameter. Similar results have beenfound by Thumaret al.[35] in

Marigold.From the present study, it was clear that increased flowerdiameter might be due to the effect of vermi-compost along with PSB and *Azotobacter.* It might alsobe due to better uptake of essential macro and micro nutrients, photosynthetic efficiency, excellentphysiological and bio chemical activities in the presence of PSB and *azotobacter.* Similar findingswere also reported by Gangadharan and Gopinath [38] in Gladiolus and Bhalla et al. [10] inCarnation.

Table 2. Effectof~~different~~organicsources~~ofnutrient~~onflowering parameterofChrysanthemum.

Treatments	Stalk length(cm)	Flower diameter(cm)	Field life (Days)	Number of flowers per plant	Number of flowers per plot	Vase life (days)	Flower weight (g)
T_1	3.73	2.74	7.41	15.16	379.16	5.83	0.57
T_2	6.24	3.32	14.28	33.70	842.66	12.75	1.10
T_3	6.46	3.36	14.77	32.66	816.66	13.44	1.12
T_4	5.27	3.02	11.00	23.83	595.83	9.14	0.85
T_5	3.73	2.85	9.66	21.15	528.75	7.92	0.71
T_6	5.35	3.15	13.29	30.75	768.75	11.79	0.93
T_7	4.23	2.81	8.54	20.25	506.25	7.75	0.70
T_8	5.45	3.23	13.52	31.23	780.83	12.23	1.02
T_9	4.27	2.78	7.80	19.08	477.08	6.58	0.61
T_{10}	5.01	2.96	11.63	22.87	571.83	13.26	0.84
T_{11}	5.96	3.26	16.10	35.16	879.16	14.55	1.04
T_{12}	5.32	3.12	12.17	28.66	716.66	10.47	0.90
T_{13}	5.30	3.06	11.89	25.98	649.58	10.31	0.86
T_{14}	4.90	2.92	9.83	22.66	566.66	8.93	0.75
Mean	5.08	3.04	11.56	26.15	653.91	10.35	0.857
CDat 5%	0.54	0.02	0.63	1.92	48.21	2.73	0.016
SE(m)±	0.18	0.00	0.21	0.66	16.49	0.93	0.005
SE(d)	0.26	0.01	0.309	0.93	23.32	1.32	0.008
C.V.	6.29	0.38	3.27	4.36	4.36	15.63	1.10

The field life of flowers was significantly differed as because single and combination effect oforganic sources of nutrients. It might be xylem and phloem activity within the plants. Increased flowerweight, field life and vase life were might be due to the effect of vermi-compost which rich in humusalong with PSB and *azotobacter* and also contain essential plant nutrients, vitamins, micro-organismsand enzymes. It helps for long term availability of nutrients for plants. Similar findings were reportedbyHemavathi [39]inChrysanthemum,Godseet al. [40]inGladiolus.

Table 3. Effectofdifferentorganicmanuresoneconomicsoforganiccultivationof Chrysanthemum

Treatments	Total cost of cultivation/ha(Rs.)	Grossreturn (Rs.)/ha	NetReturn(Rs.)/ha	B:Cratio

T_1	81966	210455	128489	1:1.56
T_2	146466	500096	353630	1:2.41
T_3	145966	485842	339876	1:2.32
T_4	123466	342886	219420	1:1.77
T_5	110466	298948	188482	1:1.70
T_6	143466	446822	303356	1:2.11
T_7	1045466	282868	177402	1:1.68
T_8	145196	455908	310712	1:2.13
T_9	102196	266300	164104	1:1.60
T_{10}	119716	328663	208947	1:1.74
T_{11}	146746	517957	371211	1:2.53
T_{12}	140446	414997	274551	1:1.95
T_{13}	132446	374289	241843	1:1.86
T_{14}	118696	322015	203319	1:1.71

* TreatmentsdetailsaredescribedinMaterialsandmethods

* SellingofChrysanthemum:50%aslooseflower @Rs.60/-perkg

* Sellingpriceof50%Chrysanthemumflower@Rs30/-perbunch (70 flowersinabunch).

TreatmentT$_{11}$alsorecordedmaximumGrossreturn(Rs517957.00/ha),netreturn(Rs.371211.00/ha),B:Cratio (1**:**2.53)andminimumwasrecorded in T$_1$(control)and presented inTable-3. Production ofmore numberofflowersmightbe due the combined application of Enrichedmanuresalongwithbio-stimulantsthatensuredsteadybutslowreleaseofessentialnutrientsthroughoutthecropgrowthperiod.

4. CONCLUSION(Rewrite your conclusion)

~~Based on the result of the present study, it may be concluded that enriched FYM @6.25 t/ha along with enriched vermi-compost @1.25 t/ha should be applied as basal dose (3weeks before transplanting) while enriched FYM@ 6.25t/ha and enriched vermi-compost @1.25t/ha can be used combined as top dressing at 30 and 60 DAT andapply seaweeds extracts @ 3 ml/l as foliar spray at 20, 40, 60 days after transplanting for better performance in morphological, quality and yield parameters in Chrysanthemum. Thiscombinationwasalsoeconomically viable for poor and marginal farmers of West Bengal. So, the treatment mightbe chosen and recommended for organic cultivation of spray Chrysanthemumin the TeraiRegionofWestBengal.~~

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ABBREVIATIONS

Cm=centimetre,g=gram,FYM=FarmYardManures,C.D=criticaldifferences,CV= Cumulativevariances.