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# Effect of Organic Manures and Liquid Formulations on Growth, Yield and quality of Chilli (*Capsicum annum* L.)

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**ABSTRACT: A field experiment was conducted during Kharif 2022 at Rajasthan College of Agriculture, MPUAT, Udaipur to study effect of organic manure and liquid formulation on growth, yield and quality of chilli (*Capsicum annum* L.). In present scenario, chilli production is constrained by adoption of low yielding cultivars, increased incidence of pest and diseases due to monocropping, improper supply of nutrients, etc. There is a need to optimise these factors of production for better yield in chilli. There is a need arise to develop simple, low cost and easily acceptable production technology for profitable and sustainable chilli production. Keeping above in mind, this experiment was designed in a Factorial Randomized Block Design, comprising twelve treatment combinations along with control. Results showed that the application of $M_2$ treatment (*i.e.* ½ RDN through NADEP compost + ½ RDN through Vermicompost) as organic manures and in Liquid formulation $F_4$ treatment (*i.e.* 10% *Jeevamrit* at 30 and 45 DAT) were found significantly highest values of various characters of chilli such as plant height, number of leaves, number of branches, leaf area index, fruit length and diameter and minimum value days to 1st flowering, 50% flowering and 1st picking respectively observed among the treatment. Among the treatment combinations, $M_2F_4$ treatment *i.e.* ½ RDN through NADEP compost + ½ RDN through Vermicompost along with the foliar spray of 10% *Jeevamrit* at 30 and 45 DAT was recorded with highest fruit length, number of fruits per plant, fruit weight, fruit yield per plot and fruit yield per hectare during investigation.**

**Keywords:** Chilli, vermicompost, NADEP compost, *Jeevamrit*, organic and liquid formulation.

## INTRODUCTION

Chilli (*Capsicum annum* L.) being also known as "King of Spices" is one of the most important commercial spice crops of India (Kondapa *et al*., 2009). It is an indispensable condiment of every Indian household. Chillies are consumed in both fresh as well as dried forms and it is a rich source of vitamin 'C' and 'A' with ample amount of minerals and good therapeutic properties (Tharmaraj *et al*., 2011). It is used in the form of oleoresin in food processing and beverage industries. The principal colouring matter is capsanthin, the carotenoid pigment which contributes about 35 per cent to the total pigments. Chilli is now gaining more reorganization in the international market because of its value added products like chilli oil, oleoresin, chilli powder and capsanthin etc (Patel *et al*., 2016). Chilli powder is the most important ground spice item exported from India.

In plant nutrition, organic manure and liquid formulation play important roles, as they act directly involves in increasing the crop yields either by acceleration of respiratory process with increasing cell permeability and hormonal growth action or by reciprocating all these processes (Palaniappan and Annadurai 1999). Vermicompost helps in lowering C: N ratio, increasing humic acid content, action exchange capacity and water soluble carbohydrates (Ramprasad *et al*., 2009). Vermicompost is a by-product of non-thermophillic biodegradation of organic materials through correlation between earthworms and microorganism (Sallaku *et al*., 2009). Neem cake is a concentrated plant based organic manure extracted from neem (*Azadirachta indica* L.) following oil extraction (as a residue). Neem cake contains not only nitrogen but alongside this, large amounts of potash and some phosphoric acid is also present. Deteriorating fertilizer use efficiency, especially of phosphorus in soils is a growing concern at global level and efforts are being made to replace the use of 100% water soluble phosphorus with that of organic carbon-related phosphorus. *Jeevamrit* encourages immense biological activity in soil and make nutrients available for the

standing crop. It is prepared by combining cow urine, cow dung, pulse flour and jaggary (*gur*), mixing them altogether and allowed to ferment for a week. *Jeevamrit* is found to have a very vast population of nitrogen fixers, phosphate solubilizers and siderophore producers (Pathak and Ram 2013). Compost tea not only upgrades the quality of fruits and vegetables but also increases leaf size of the plant, improves soil and enhances the growth of plants, balance nutrition and increases diseases resistance. Compost tea promotes immense biological activities in soil and provide the nutrients available to crop (Pandia *et al*., 2019).

## MATERIAL AND METHOD

The present investigation was laid out during 2022 at Horticulture Farm, Rajasthan College of Agriculture, MPUAT, Udaipur (24°35' N latitude and 72°42' E longitude and at an elevation of 582.17 m above mean sea level). The soil of experimental field was clay loam in texture, slightly alkaline low in organic carbon (0.68 %), nitrogen (194.8 kg/ha), available phosphorus (17.1 kg/ha), high in potassium (255.3 kg/ha) Udaipur. The experiment was laid out in a Factorial Randomized Block Design (FRBD) with three replications.

The experiment included the 13 treatment combinations comprising organic manure and liquid formulations. The recommended dose of fertilizer for chilli crop is 90:80:80 kg NPK/ha as per the package of practices for the Agro-climatic zone-IV a of Rajasthan state. Four weeks old healthy seedlings of variety Arka Meghna of chilli were transplanted in already prepared beds at a spacing of 45 × 60 $cm^2$ during evening hours in the first week of July, 2022. The details of used organic manures and liquid formulations and their combination are given as under:

| **Treatment Details** | | |
|---|---|---|
| **(A) Organic Manure** | | |
| **$M_1$** | **:** | ½ RDN through neem cake + ½ RDN through vermicompost |
| **$M_2$** | **:** | ½ RDN through NADEP compost + ½ RDN through vermicompost |
| **$M_3$** | **:** | ½ RDN through neem cake + ½ RDN through NADEP compost |
| **(B) Liquid Formulation** | | |
| **$F_1$** | **:** | 10% *Vermiwash* spray at 30 and 45 DAT |
| **$F_2$** | **:** | 5% *Panchgavya* spray at 30 and 45 DAT |
| **$F_3$** | **:** | 20% Compost tea spray at 30 and 45 DAT |
| **$F_4$** | **:** | 10% *Jeevamrit* by drenching at 30 and 45 DAT |
| **(C) Control (No Manure + Water spray at 30 and 45 DAT)** | | |
| (Note :- BD-500 is common combination with liquid formulations) | | |

| **TREATMENT COMBINATION** | | | |
|---|---|---|---|
| **Treatment No.** | | **Treatment combination** | **Notation** |
| **$T_1$** | **:** | ½ RDN through neem cake + ½ RDN through vermicompost + 10% *Vermiwash*spray at 30 and 45 DAT | $M_1F_1$ |
| **$T_2$** | **:** | ½ RDN through neem cake + ½ RDN through vermicompost + 5% *Panchgavya* spray at 30 and 45 DAT | $M_1F_2$ |
| **$T_3$** | **:** | ½ RDN through neem cake + ½ RDN through vermicompost + 20% Compost tea spray at 30 and 45 DAT | $M_1F_3$ |
| **$T_4$** | **:** | ½ RDN through neem cake + ½ RDN through vermicompost + 10% *Jeevamrit* spray at 30 and 45 DAT | $M_1F_4$ |
| **$T_5$** | **:** | ½ RDN through NADEP compost + ½ RDN through vermicompost + 10% *Vermiwash* spray at 30 and 45 DAT | $M_2F_1$ |
| **$T_6$** | **:** | ½ RDN through NADEP compost + ½ RDN through vermicompost + 5% *Panchgavya* spray at 30 and 45 DAT | $M_2F_2$ |
| **$T_7$** | **:** | ½ RDN through NADEP compost + ½ RDN through vermicompost + 20% Compost tea spray at 30 and 45 DAT | $M_2F_3$ |
| **$T_8$** | **:** | ½ RDN through NADEP compost + ½ RDN through vermicompost + 10% *Jeevamrit* by drenching at 30 and 45 DAT | $M_2F_4$ |
| **$T_9$** | **:** | ½ RDN through neem cake + ½ RDN through NADEP compost + 10% *Vermiwash* spray at 30 and 45 DAT | $M_3F_1$ |
| **$T_{10}$** | **:** | ½ RDN through neem cake + ½ RDN through NADEP compost + 5% *Panchgavya* spray at 30 and 45 DAT | $M_3F_2$ |
| **$T_{11}$** | **:** | ½ RDN through neem cake + ½ RDN through NADEP compost + 20% Compost tea spray at 30 and 45 DAT | $M_3F_3$ |
| **$T_{12}$** | **:** | ½ RDN through neem cake + ½ RDN through NADEP compost + 10% *Jeevamrit* by drenching at 30 and 45 DAT | $M_3F_4$ |
| **$T_{13}$** | **:** | Control (No Manure + Water spray at 30 and 45 DAT) | $M_0F_0$ |

**Observations Recorded**

**Growth characters**

**Plant height (cm).** Five plants were randomly selected in each plot and tagged. The plant height was measured at 30, 60, 90 DAT and at last picking from base of the plant to tip of the main shoot by meter scale and average height of five plants were recorded as mean plant height (cm).

**Number of leaves per plant.** The number of leaves per plant was measured at 30, 60, 90 DAT and at last picking of five randomly selected plants in each plot and average number of leaves of five plants were recorded as mean number of leaves.

**Number of branches per plant.** The number of branches per plant was measured at 30, 60, 90 DAT and at last picking of five randomly selected plant each plot and average number of branches of five plant were recorded as mean number of branches.

**Days to 1st flowering after transplanting.** Days taken from the day of transplanting to initiation of flower on the plants from the five labelled plants and mean was calculated

**Days to 50% flowering after transplanting.** Five randomly selected plants were tagged and the number of days taken to 50% flowering were counted from the date of transplanting and average value was taken as days to 50% flowering.

**Days to 1st picking after transplanting.** Five randomly selected plants were tagged and the number of days taken to first harvest were counted from the date of sowing and average value was taken as days to first harvest

**Leaf area index (LAI).** Leaf area index is defined as leaf area (assimilatory source) per unit land area. It was calculated at harvest as per the formula.

$$\text{LAI} = \frac{\text{Leaf area (cm}^2\text{)}}{\text{Spacing}}$$

**Yield parameters**

**Fruit length (cm).** The length of five fresh fruits harvested from randomly selected and tagged five plants was taken during harvesting and the average length of fruit was calculated by mean weight of ten plants.

**Fruit diameter (cm).** The fruit diameter was measured from five representative fruits from each treatment. After harvesting the fruits horizontally from the middle, diameter of the fruit was measured in cm and mean value was recorded.

**Fruit weight (g).** The fruits attain horticulture maturity were harvested and weight of individual fruit was recorded in grams using a weighing balance and the mean fruit weight was recorded.

**Number of fruits per plant.** The total number of fruit (marketable) were counted for five tagged plants from each bed and averaged.

**Fruit yield per plant (g).** Yield was weighed and recorded in gram for five randomly chosen plants from each bed and then averaged for a plant.

**Fruit yield per plot (kg).** The fresh fruits harvested from each plot including five tagged plants were weight at each harvesting and total weight of all the harvesting of each plot was calculated in kilograms.

**Fruit yield per hectare (t).** The fruit yield per hectare was calculated by using the following formula and expressed in t/ha

$$\text{Fruit yield (t/ha)} = \frac{\text{Fruit weight (kg plant}^{-1}\text{)} \times \text{No. of plants ha}^{-1}}{1000}$$

## RESULT AND DISCUSSION

**Effect on Growth Characters**

**Effect of Organic Manure (M).** The effect of organic manure on growth characters was recorded significant during research. The highest value of plant height (*i.e.* 18.03, 41.37, 63.00 and 83.45 cm on 30, 60, 90 and last day picking stage, respectively), number of leaves per plant (*i.e.* 26.20, 51.18, 65.73 and 85.73 on 30, 60, 90 and last day picking stage, respectively), number of branches per plant (*i.e.*5.72, 11.72, 21.90 and 30.67 at 30, 60, 90 and last day picking stage, respectively) and leaf area index (*i.e.* 1.84) were observed with $M_2$treatment (*i.e.*½ RDN through NADEP compost + ½ RDN through Vermicompost) while, minimum value of plant height (*i.e.* 13.15, 35.33, 53.02 and 71.97 cm on 30, 60, 90 and last day picking stage, respectively), number of leaves per plant (*i.e.* 20.88, 43.42, 58.42 and 78.50 on 30, 60, 90 and last day picking stage, respectively), number of branches per plant (*i.e.*4.00, 9.80, 19.13 and 2.13 at 30, 60, 90 and last day picking stage, respectively) and leaf area index (*i.e.* 1.77) was recorded with $M_3$treatment (½ RDN through neem cake + ½ RDN through NADEP compost). However, The significantly minimum days to 1st flowering after transplanting (*i.e.*30.03), days to 50% flowering after transplanting (*i.e.* 44.65) and days to 1st picking after transplanting (*i.e.*62.28) was showed under $M_2$ treatment (½ RDN through NADEP compost + ½ RDN through Vermicompost), however, maximum days to 1st flowering after transplanting (*i.e.* 51.69), days to 50% flowering after transplanting (*i.e.* 51.69) and days to 1st picking after transplanting (*i.e.*70.23) was found under $M_3$ (*i.e.*½ RDN through neem cake + ½ RDN through NADEP compost) (Table:1 and 2). Nutrient management by using Vermicompost, Neem cake and NADEP compost enhanced chemical, physical and biological properties of soil by accelerating root growth which might have resulted an increment in absorption and efficient translocation of nutrients during vegetative growth of plant system. It would be relevant to recall here that nitrogen fixation can be boosted by Vermicompost and NADEP compost has ability of inhibiting nitrification thereby increased nitrogen availability in plant. Plants can take up the required nutrient according their demand resulting in improved growth and development. Phosphorus is known as key factor of life because it plays a vital role in all physiological processes in plant. Vermicompost is rich source of phosphorus and NADEP compost has phosphorus solubilizing effect. So, it elevates absorption and translocation of phosphorus in plants. The above finding is in accordance with finding of Ankaram *et al*. (2013); Singh *et al*. (2014); Kumar *et al.* (2020); Khurshid *et al.* (2021) in chilli, Ganeshnauth*et al*. (2018) in pepper plant, Kumar *et al.* (2017) in pea crop.

**Effect of Liquid Formulation (F).** The liquid formulation exhibited significant effect with all growth characters of chilli. The highest plant height (*i.e.* 16.87, 39.80, 60.38 and 80.51 cm at 30, 60, 90 DAT and at last picking stage), number of leaves per plant (*i.e.* 24.73, 48.93, 64.04 and 84.04 at 30, 60, 90 DAT and at last picking stage), number of branches per plant (*i.e.*5.38, 11.40, 21.38 and 30.22 at 30, 60, 90 DAT and at last picking stage), leaf area index (*i.e.* 1.82) and minimum days to 1st flowering after transplanting (*i.e.* 30.76), days to 50% flowering after transplanting (*i.e.* 46.30) and days to 1st picking after transplanting (*i.e.*64.07) was observed with $F_4$ treatment (*i.e*. 10% *Jeevamrit* spray) while, lowest plant height recorded (*i.e.* 15.20, 37.53, 57.16 and 75.73 cm at 30, 60, 90 DAT and at last picking stage), number of leaves per plant (*i.e.* 22.60, 46.07, 60.64 and 80.64 at 30, 60, 90 DAT and at last picking stage), number of branches per plant (*i.e.* 4.62, 10.40, 20.18 and 28.87 at 30, 60, 90 DAT and at last picking stage) and maximum days to 1st flowering after transplanting (*i.e.* 31.91), days to 50% flowering after transplanting (*i.e.* 49.55) and days to 1st picking after transplanting (*i.e.*67.13) was noticed with $F_2$ treatment (*i.e*. 5% *Panchgavya* spray) (Table 1 and 2). *Jeevamrit* contains macronutrients such as N, P, K and micronutrients that is required for various vitamins, amino acids, growth regulators such as auxins and gibberellins which are necessary for proper growth and development of plants. Similar results were recorded by Deore *et al.* (2010); Gopal *et al*. (2014); Rao *et al*. (2015); Sundararasu (2016) in chilli.

**Effect of Interaction of Organic Manure and Liquid Formulation (MXF).** The interaction of organic manure and liquid formulation (M×F) was recorded significant with maximum plant height (*i.e.* 6.80 cm at 30 DAT), number of leaves of per plant (*i.e.*54.13 at 60 DAT) and minimum days to 1st picking after transplanting (*i.e.* 60.87) recorded with $M_2F_4$ combination treatment (*i.e.* ½ RDN through NADEP compost + ½ RDN through Vermicompost + 10% *Jeevamrit*) while, minimum plant height recorded with (*i.e.*10.40 cm at 30 DAT), number of leaves per plant (*i.e*25.53 at 60 DAT) and maximum days to 1st picking after transplanting (*i.e.*80.87) reported with $M_0F_0$ treatment *i.e.* Control (*i.e.* No Manure + Water spray) (Table 1 and 2).

The interaction of organic manure and liquid formulation (M×F) was showed non-significant with number of branches, days to 1st flowering after transplanting, days to 50% flowering after transplanting and leaf area index. The combined use of organic manures and liquid formulations are useful in maintaining and sustaining higher status of soil fertility and availability of nutrient to crop. The goal is to meet the crop nutrient requirement as per demand at different stages which can enhance productivity of crops. Rising organic matter in soil due to vermicompost use was subjected to microbial decomposition leading to production of carbonic acid and other organic acids. This might lead to the reduction in soil pH and also to augmented availability of P and other nutrients to crop plants for good growth and development. It is important to highlight here that soil pH has considerable effect on availability of essential nutrients. NADEP compost was found effective in enhancing the nitrogen and phosphorus content in soil and it has nitrification inhibiting properties and slow release of $N_2$. *Jeevamrit* has growth hormones such as auxins and gibberellins which promotes growth of plants. Similar observation was recorded by Awadhpersad *et al.* (2021) in tomato plants, Khurshid *et al.* (2021); Sujana *et al*. (2019) in chilli.

**Effect on Yield Parameters**

**Effect of Organic Manure (M).** The yield parameters of chilli were significantly affected by organic manures application. Significantly maximum fruit diameter (*i.e.* 0.75 cm), fruit weight (*i.e*. 5.37 g), number of fruits per plant (*i.e.* 86.97), fruit yield per plant (*i.e.* 466.71 g), fruit yield per plot (kg) and fruit yield per hectare (*i.e.* 17.27 t) exhibited with $M_2$ treatment (*i.e.* ½ RDN through NADEP compost + ½ RDN through Vermicompost) while lowest in fruit diameter (*i.e.*0.64 cm), fruit weight (*i.e.*4.25g), number of fruit per plant (*i.e.* 84.35), fruit yield per plant(*i.e.* 358.32 g ), fruit yield per plot (*i.e.* 8.96 kg) and fruit yield per hectare (*i.e.* 13.26 t) showed with $M_3$ treatment (½ RDN through neem cake + ½ RDN through NADEP compost) (Table 2). A significant effect of vermicompost and NADEP compost for augmented yield might enhanced establishment of micro-organism population in rhizosphere as the organic matter in addition providing physical properties also insured nutrient availability and food supply for plants. Phosphorus plays crucial role in protein synthesis, chlorophyll and for establishment of good root mass. Similar finding was recorded through use of organic manures by Deshpande *et al*. (2010); Kumar and Dahiya (2013); Khandaker *et al.* (2017); Reddy *et al*. (2017); Kumar *et al.* (2020) in chilli crop and Eswaran and Mariselvi (2016) in tomato crop.

**Effect of Liquid Formulation (F).** The effect of liquid formulations was noticed significant on yield parameters of chilli. The maximum fruit length (*i.e.* 6.96 cm), fruit diameter (*i.e.*0.73 cm), fruit weight (*i.e.*5.05 g), number of fruit per plant (*i.e.*86.49), fruit yield per plant(*i.e.*437.81 g), fruit yield per plot (*i.e.*10.95 kg) and fruit yield per hectare (*i.e.*16.20 t ) showed with $F_4$ treatment (*i.e.* 10% *Jeevamrit* spray) while, minimum fruit length (*i.e.*6.46 cm), fruit diameter (*i.e.*0.67 cm), fruit weight (*i.e.*0.74 g), number of fruit per plant (*i.e.*85.22), fruit yield per plant(*i.e.*409.48 g), fruit yield per plot (*i.e.*10.95 kg) and fruit yield per hectare (*i.e.*16.20 t)was reported with $F_2$ treatment (*i.e*. 5% *Panchgavya*spray) (Table:2).It depicts that highest yield can be achieved with 10% *Jeevamrit* on chilli plant because higher concentration of bio-manures contains ample amount of nutrients and essential supplements at higher concentration which is needed for the growth and development of plants. Early flowering maybe due to integration effect of *Jeevamrit* which contains soil microbes, cyanobacteria, PSB and growth hormones such as auxin, gibberellin and

cytokinin's all of which influence and enhance nitrogen, phosphorus, potassium and essential nutrients efficiency a way that chemical fertilizers do not. Similar response was noticed by Chandrakala *et al.* (2011); Boraiah *et al*. (2017); Chandrakala and Hebsur (2020); Hathi *et al*. (2022) in chilli, Bharadwaj *et al.* (2021) in pea.

**Interactive effect of organic manure and liquid formulation (M × F).** The combined effect of organic manures and liquid formulations was reported significant on yield parameters of chilli. The highest fruit yield per plant (*i.e.* 494.82 g), fruit yield per plot (*i.e.*12.37 kg) and fruit yield per hectare (*i.e.*18.31 t) showed with $M_2F_4$ combination treatment (*i.e.*½ RDN through NADEP compost + ½ RDN through Vermicompost + 10% *Jeevamrit*) whereas, minimum fruit yield per plant (*i.e.*215.79 g), fruit yield per plot (*i.e.*5.39 kg) and fruit yield per hectare (*i.e.*7.98 t) with $M_0F_0$ treatment *i.e.* Control (*i.e.* No Manure + Water spray) (Table 2). The effect of interaction of organic manure and liquid formulation (M×F) on fruit length, fruit diameter, fruit weight and number of fruits per plant were found non-significant. The enhanced yield with organic manures may be explained that the accumulation of inorganic nitrogen was restricted and NADEP compost has anti-nitrification ability and proper amount of phosphorus is obtained from vermicompost. Phosphorus is vital for all physiological processes of crops. Other factor responsible for higher number of fruits per plant and yield might be due to the more availability, better decomposition, higher content of essential plant nutrients and more balanced C:N ratio from organic manures which have accelerated the carbohydrate synthesis in return enhanced plant growth, increase in yield characters, influences the microbial activity, nitrification regulating property and higher sulphur content of vermicompost which have controlled the soil borne pest and diseases and upgrade soil structure. Similar results were noticed by Bade *et al*. (2017) in chilli crop.

**Table 1: Effect of organic manures, liquid formulations and their interactions on growth parameter of chilli**

| Treatment | Plant Height (cm) | | | | Number of Leaves per Plant | | | | Number of Branches per Plant | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30 DAT | 60 DAT | 90 DAT | At last picking | 30 DAT | 60 DAT | 90 DAT | At last picking | 30 DAT | 60 DAT | 90 DAT | At last picking |
| **Organic Manures (M)** | | | | | | | | | | | | |
| $M_1$ | 16.13 | 38.03 | 58.83 | 77.68 | 23.22 | 46.65 | 61.65 | 81.65 | 4.82 | 10.72 | 20.58 | 29.25 |
| $M_2$ | 18.03 | 41.37 | 63.00 | 83.45 | 26.20 | 51.18 | 65.73 | 85.73 | 5.72 | 11.72 | 21.90 | 30.67 |
| $M_3$ | 13.15 | 35.33 | 53.02 | 71.97 | 20.88 | 43.42 | 58.42 | 78.50 | 4.00 | 9.80 | 19.13 | 28.13 |
| **SEm±** | **0.19** | **0.46** | **0.48** | **0.54** | **0.45** | **0.36** | **0.43** | **0.55** | **0.16** | **0.19** | **0.30** | **0.22** |
| **CD at 5 %** | **0.56** | **1.34** | **1.41** | **1.58** | **1.30** | **1.04** | **1.26** | **1.62** | **0.46** | **0.55** | **0.89** | **0.63** |
| **Liquid Formation (F)** | | | | | | | | | | | | |
| $F_1$ | 15.20 | 37.53 | 57.38 | 76.84 | 22.80 | 46.07 | 61.00 | 81.11 | 4.62 | 10.44 | 20.18 | 28.93 |
| $F_2$ | 15.16 | 37.49 | 57.16 | 75.73 | 22.60 | 46.07 | 60.64 | 80.64 | 4.62 | 10.40 | 20.09 | 28.87 |
| $F_3$ | 15.87 | 38.16 | 58.22 | 77.71 | 23.60 | 47.27 | 62.04 | 82.04 | 4.76 | 10.73 | 20.51 | 29.38 |
| $F_4$ | 16.87 | 39.80 | 60.38 | 80.51 | 24.73 | 48.93 | 64.04 | 84.04 | 5.38 | 11.40 | 21.38 | 30.22 |
| **SEm±** | **0.22** | **0.53** | **0.56** | **0.63** | **0.51** | **0.41** | **0.50** | **0.64** | **0.18** | **0.22** | **0.35** | **0.25** |
| **CD at 5 %** | **0.65** | **1.55** | **1.63** | **1.83** | **1.50** | **1.20** | **1.46** | **1.87** | **0.53** | **0.64** | **1.02** | **0.73** |
| **Interaction (MxF)** | | | | | | | | | | | | |
| $M_1F_1$ | 16.13 | 37.87 | 58.53 | 77.80 | 22.80 | 46.20 | 61.20 | 81.20 | 4.73 | 10.53 | 20.47 | 29.33 |
| $M_1F_2$ | 15.73 | 36.93 | 56.93 | 74.13 | 22.27 | 44.67 | 59.67 | 79.67 | 4.53 | 10.40 | 20.40 | 28.80 |
| $M1F_3$ | 16.20 | 38.40 | 59.67 | 78.73 | 23.53 | 47.47 | 62.47 | 82.47 | 4.93 | 10.87 | 20.53 | 29.40 |
| $M_1F_4$ | 16.47 | 38.93 | 60.20 | 80.07 | 24.27 | 48.27 | 63.27 | 83.27 | 5.07 | 11.07 | 20.93 | 29.47 |
| $M_2F_1$ | 17.13 | 39.87 | 60.80 | 80.87 | 24.80 | 48.67 | 63.47 | 83.47 | 5.20 | 11.13 | 21.07 | 29.73 |
| $M_2F_2$ | 18.07 | 41.40 | 63.20 | 83.27 | 25.93 | 51.33 | 65.07 | 85.07 | 5.60 | 11.60 | 21.67 | 30.33 |
| $M_2F_3$ | 17.67 | 40.40 | 61.73 | 82.27 | 25.87 | 50.60 | 64.93 | 84.93 | 5.27 | 11.27 | 21.40 | 30.13 |
| $M_2F_4$ | 19.27 | 43.80 | 66.27 | 87.40 | 28.20 | 54.13 | 69.47 | 89.47 | 6.80 | 12.87 | 23.47 | 32.47 |
| $M_3F_1$ | 12.20 | 34.73 | 52.80 | 71.87 | 20.80 | 43.33 | 58.33 | 78.67 | 3.93 | 9.67 | 18.73 | 27.73 |
| $M_3F_2$ | 11.80 | 34.27 | 51.33 | 69.80 | 19.60 | 42.20 | 57.20 | 77.20 | 3.73 | 9.20 | 18.47 | 27.47 |
| $M_3F_3$ | 13.73 | 35.67 | 53.27 | 72.13 | 21.40 | 43.73 | 58.73 | 78.73 | 4.07 | 10.07 | 19.60 | 28.60 |
| $M_3F_4$ | 14.87 | 36.67 | 54.67 | 74.07 | 21.73 | 44.40 | 59.40 | 79.40 | 4.27 | 10.27 | 19.73 | 28.73 |
| $M_0F_0$ | 10.40 | 22.40 | 43.20 | 60.13 | 12.73 | 25.53 | 40.53 | 60.50 | 2.60 | 7.13 | 13.73 | 21.80 |
| **SEm±** | **0.38** | **0.92** | **0.97** | **1.08** | **0.89** | **0.71** | **0.87** | **1.11** | **0.31** | **0.38** | **0.61** | **0.43** |
| **CD at 5 %** | **1.12** | **2.69** | **2.82** | **3.16** | **2.60** | **2.08** | **2.53** | **3.23** | **0.92** | **1.10** | **1.77** | **1.26** |

**TREATMENT DETAILS**

**(A) Organic Manure:** **$M_1$**(½ RDN through neem cake + ½ RDN through vermicompost), **$M_2$**(½ RDN through NADEP compost + ½ RDN through vermicompost) and **$M_3$** (½ RDN through neem cake + ½ RDN through NADEP compost)

**(B) Liquid Formulation:** **$F_1$** (10% *Vermiwash* spray at 30 and 45 DAT), **$F_2$**(5% Panchgavya spray at 30 and 45 DAT), **$F_3$** (20% Compost tea spray at 30 and 45 DAT) and **$F_4$**(10% Jeevamrit by drenching at 30 and 45 DAT)

**Table 2: Effect of organic manures and liquid formulation and their interactions on yield parameter of chilli.**

| Treatment | Days to 1st flowering | Days to 50% flowering DAT | Days to 1st picking | Leaf area index (LAI) | fruit length (cm) | Fruit diameter (cm) | Fruit weight (g) | Number of fruits per plant | Fruit yield per plant (g) | Fruit yield per plot (kg) | Fruit yield per hectare (t) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Organic Manures (M)** | | | | | | | | | | | |
| $M_1$ | 31.58 | 48.06 | 64.93 | 1.81 | 6.55 | 0.68 | 4.91 | 85.52 | 420.21 | 10.51 | 15.55 |
| $M_2$ | 30.03 | 44.65 | 62.28 | 1.84 | 7.30 | 0.75 | 5.37 | 86.97 | 466.71 | 11.67 | 17.27 |
| $M_3$ | 32.73 | 51.69 | 70.23 | 1.77 | 6.04 | 0.64 | 4.25 | 84.35 | 358.32 | 8.96 | 13.26 |
| **SEm±** | **0.15** | **0.44** | **0.18** | **0.01** | **0.16** | **0.015** | **0.01** | **0.27** | **0.95** | **0.02** | **0.04** |
| **CD at 5 %** | **0.45** | **1.28** | **0.51** | **0.01** | **0.45** | **0.043** | **0.02** | **0.78** | **2.78** | **0.08** | **0.10** |
| **Liquid Formation (F)** | | | | | | | | | | | |
| $F_1$ | 31.71 | 48.79 | 66.62 | 1.80 | 6.51 | 0.68 | 4.80 | 85.29 | 409.48 | 10.24 | 15.15 |
| $F_2$ | 31.91 | 49.55 | 67.13 | 1.80 | 6.46 | 0.67 | 4.74 | 85.22 | 404.19 | 10.10 | 14.96 |
| $F_3$ | 31.42 | 47.89 | 65.44 | 1.81 | 6.58 | 0.68 | 4.78 | 85.44 | 408.84 | 10.22 | 15.13 |
| $F_4$ | 30.76 | 46.30 | 64.07 | 1.82 | 6.96 | 0.73 | 5.05 | 86.49 | 437.81 | 10.95 | 16.20 |
| **SEm±** | **0.18** | **0.51** | **0.20** | **0.01** | **0.18** | **0.02** | **0.01** | **0.31** | **1.10** | **0.03** | **0.04** |
| **CD at 5 %** | **0.52** | **1.48** | **0.56** | **0.02** | **0.53** | **0.05** | **0.02** | **0.90** | **3.21** | **0.08** | **0.12** |
| **Interaction (MxF)** | | | | | | | | | | | |
| $M_1F_1$ | 31.73 | 48.78 | 65.80 | 1.80 | 6.53 | 0.68 | 4.87 | 85.40 | 415.90 | 10.40 | 15.39 |
| $M_1F_2$ | 31.80 | 49.27 | 66.40 | 1.79 | 6.37 | 0.67 | 4.78 | 85.20 | 407.54 | 10.19 | 15.08 |
| $M_1F_3$ | 31.53 | 47.27 | 64.27 | 1.81 | 6.57 | 0.68 | 4.88 | 85.40 | 416.47 | 10.41 | 15.41 |
| $M_1F_4$ | 31.27 | 46.91 | 63.27 | 1.83 | 6.71 | 0.69 | 5.12 | 86.07 | 440.95 | 11.02 | 16.32 |
| $M_2F_1$ | 30.87 | 46.60 | 62.93 | 1.83 | 6.96 | 0.71 | 5.13 | 86.20 | 442.49 | 11.06 | 16.37 |
| $M_2F_2$ | 30.07 | 44.80 | 62.40 | 1.83 | 7.11 | 0.74 | 5.47 | 86.80 | 475.07 | 11.88 | 17.58 |
| $M_2F_3$ | 30.27 | 45.27 | 62.93 | 1.83 | 7.09 | 0.71 | 5.26 | 86.40 | 454.46 | 11.36 | 16.82 |
| $M_2F_4$ | 28.93 | 41.93 | 60.87 | 1.86 | 8.04 | 0.84 | 5.59 | 88.47 | 494.82 | 12.37 | 18.31 |
| $M_3F_1$ | 33.13 | 53.27 | 71.13 | 1.77 | 6.05 | 0.64 | 4.20 | 84.27 | 354.19 | 8.85 | 13.10 |
| $M_3F_2$ | 33.27 | 52.30 | 72.60 | 1.76 | 5.90 | 0.63 | 4.13 | 83.67 | 345.83 | 8.65 | 12.80 |
| $M_3F_3$ | 32.47 | 51.13 | 69.13 | 1.77 | 6.07 | 0.65 | 4.21 | 84.53 | 355.60 | 8.89 | 13.16 |
| $M_3F_4$ | 32.07 | 50.07 | 68.07 | 1.79 | 6.13 | 0.66 | 4.45 | 84.93 | 377.66 | 9.44 | 13.97 |
| $M_0F_0$ | 40.60 | 61.67 | 80.67 | 1.64 | 5.82 | 0.62 | 3.08 | 70.07 | 215.79 | 5.39 | 7.98 |
| **SEm±** | **0.31** | **0.88** | **0.35** | **0.01** | **0.31** | **0.029** | **0.02** | **0.54** | **1.90** | **0.05** | **0.07** |
| **CD at 5 %** | **0.90** | **2.56** | **1.03** | **0.02** | **0.91** | **0.086** | **0.04** | **1.57** | **5.56** | **0.14** | **0.21** |

**TREATMENT DETAILS**
**(A) Organic Manure: $M_1$**(½ RDN through neem cake + ½ RDN through vermicompost), **$M_2$**(½ RDN through NADEP compost + ½ RDN through vermicompost) and **$M_3$** (½ RDN through neem cake + ½ RDN through NADEP compost)
**(B) Liquid Formulation: $F_1$** (10% *Vermiwash* spray at 30 and 45 DAT), **$F_2$**(5% Panchgavya spray at 30 and 45 DAT), **$F_3$** (20% Compost tea spray at 30 and 45 DAT) and **$F_4$**(10% Jeevamrit by drenching at 30 and 45 DAT)

## CONCLUSIONS

It was concluded from the study that application of $M_2$ treatment (*i.e.* ½ RDN through NADEP compost + ½ RDN through Vermicompost) as organic manures and in Liquid formulation $F_4$ treatment (*i.e.* 10% *Jeevamrit* at 30 and 45 DAT) were found significantly with all growth and yield parameters. Among the treatment combinations, $M_2F_4$ treatment *i.e.* ½ RDN through NADEP compost + ½ RDN through Vermicompost along with the foliar spray of 10% *Jeevamrit* at 30 and 45 DAT was recorded with highest fruit length (*i.e.*8.04 cm), number of fruits per plant (*i.e.*88.47), fruit weight (*i.e.*5.59g), fruit yield per plot (*i.e.*12.37 kg) and fruit yield per hectare (*i.e.*18.31t).

## FUTURE SCOPE

Further studies are required to understand the long-term effect of organic manures and liquid formulation application on chilli production. Furthermore, it is important to develop a proper simulation model to elucidate the long-term effect of organic amendments on growth and yield of chilli peppers. Despite forecast uncertainties, the project model allows improving the efficiency of agricultural management practices in various surroundings.

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