Effect of liquid organic foliar spray on chickpea (*Cicer arietinum* L.) under rainfed condition

ABSTRACT

Aims: Foliar nutrition is aimed to eliminate the problems of fixation and immobilization of nutrients. Hence, foliar nutrition is being recognized as a significant way of fertilizing modern agriculture, especially under rainfed conditions. Liquid organic manures are the concoctions of micro and macronutrients that also contain vitamins, amino acids, growth-promoting substances, and beneficial microbes.

Study design: The experiment was laid out in a split plot design with three replications.

Place and Duration of Study: A field experiment was conducted in medium black soils at Regional Agricultural Research Station, Vijayapur, during *Rabi,* 2020-21.

Methodology: There were fifteen treatment combinations, consisting of five organic sources (vermiwash @ 10%, cowurine @ 10%, jeevamrutha @ 25%, bio digester filtrate @ 25% and urea @ 2%) in main plots and three stage of application (pre flowering, pod initiation and pre flowering + pod initiation) in sub plots for JG-11 variety of chickpea.

Results: Foliar application of jeevamrutha @ 25% both at pre flowering and at pod initiation stages recorded significantly greater dry matter accumulation in leaves, stem and reproductive parts, higher SPAD values, number of pods plant^{-1} (46.5), grain weight plant^{-1} (9.45 g), harvest index (2198 kg ha^{-1}). Soil dehydrogenase activity, protein content and protein yield parameters also showed higher values for the same treatment along with the major nutrient uptake. A significant reduction in the observation of pest load of chickpeas at pod development stage was noticed by the application of treatment.

Conclusion: Foliar application of liquid organic manures, either jeevamrutha @ 25% or cow urine @ 10% both at pre-flowering and at pod initiation stages helped to increase growth, growth attributes like dry matter accumulation, SPAD values, yield attributes, protein content, dehydrogenase activity, major nutrient uptake and reduction of pest load in chickpea.

Keywords: Chickpea, Foliar nutrition, Jeevamrutha, Organics, Pod borer, Vermiwash

1. INTRODUCTION

"Pulses play a major role in Indian agriculture for sustainable production, improvement in soil health, and maintaining environmental safety. Chickpea (*Cicer arietinum* L.) is one of the most prominent pulse crops not only in India but also in the world. India ranks first in area (10.56 million ha) and production (11.17 million tonnes) of chickpeas in the world, with a productivity of 1077 kg ha^{-1}" [1]. "In India, Karnataka ranks fourth in the cultivation of chickpeas with an area of 8.64 lakh ha and annual production of 6.75 lakh tonnes, and average productivity was 782 kg ha^{-1}" [2].

In order to complement the nutritional needs of crops, foliar spraying nutrients coupled with soil treatment provides a number of benefits. India's dry land tracts experience moisture deficits, which reduce production since fewer nutrients are available there. With this approach, nutrients are used more effectively and shortages are quickly corrected. New generation special fertilizers that are just intended for foliar feeding and fertilization have recently been launched. Increased nutrition availability and favorable plant response led to improved nutrient transfer to reproductive structures including pods, grains, etc. [3].

"When nutrients are few or insufficient in the soil, the most cost-effective method of delivering them to the plant is through foliar fertilization. Foliar nutrition's main benefit is that it frequently results in an immediate improvement in plant growth and development. In order to achieve improved yield, quality, pest resistance, and drought tolerance, foliar fertilization, also known as foliar feeding, encourages the delivery of nutrients, plant growth, stimulants, and other beneficial substances in liquid form to plants through aerial parts of the plants, such as leaves, stems, and other plant parts. It also aids in the recovery of the plants from transplant shock, hail damage, or the effects of other weather extremes. One of the various methods for supplying nutrients at crucial phases is additional foliar treatment. It is essential to provide nutrients by foliar spray at the right phases of growth in order to maximize their uptake and the crop's performance" [4].

In India, almost 57 species of insects and other arthropods attack the chickpea crop [5]. Pod borer, *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae), is the most important of them all, accounting for 90-95 percent of all insect-pest damage [6]. It is a polyphagous, multivoltine, diapause, and cosmopolitan pest, and these characteristics contribute to its serious pest status. The insect attacks chickpea seedlings and feeds on blooms, pods, and developing seeds until the crop matures [7]. Nowadays, due to the increase in awareness of health consciousness among people, organic products are gaining importance. As a result, botanical extracts appear to be a viable alternative to chemicals in the treatment of chickpea pod borer. Organics like vermiwash, cow urine, and biodigester filtrate have some insecticidal properties, upon foliar spray control pest population up to some extent in the organic cultivation system.

Beejamrutha, Jeevamrutha, and Panchagavya are examples of liquid organic solutions that are made from cow dung, urine, milk, curd, ghee, bean flour, and jaggery. Additionally, macronutrients, important micronutrients, many vitamins, vital amino acids, growth-promoting substances including indole acetic acid and gibberellic acid, and helpful bacteria may be found in vermiwash and cow urine. Thus, the goal of the current study is to determine the effects of foliar nutrient sprays from organic sources and application stage on chickpea production traits, yield and economics under rainfed conditions [8].

2. MATERIAL AND METHODS

A field experiment was conducted during *Rabi*, 2020-21 at Regional Agricultural Research Station, Vijayapur, Karnataka on *Vertisol* having pH 8.32 and EC 0.24 dS m^{-1}. The soil was medium in organic carbon content (0.51 %) and available P_2O_5 (31 kg ha^{-1}), and low in available N (168 kg ha^{-1}) with high available K_2O content (342 kg ha^{-1}). The experimental site was located at a latitude of 16˚ 77´ North, longitude of 75˚ 74´ East and an altitude of 516.29 meters above mean sea level in Northern Dry Zone of Karnataka (Zone 3). The experiment was laid out in split plot design with three replications. There were fifteen treatment combinations, consisting five organic sources (vermiwash @ 10%, cowurine @ 10%, jeevamrutha @ 25%, biodigester filtrate @ 25% and urea @ 2%) in main plots and three stage of application (pre flowering, pod initiation and pre flowering + pod initiation) in sub plots.

During the cropping period of 2020-21, a total rainfall of 865.5 mm was received in 51 rainy days from April 2020 to March 2021 as against the normal rain of 594.4 mm which was received in 38 rainy days. The maximum monthly temperature over the years (1981-2019) was the highest in the month of May (39.6 □), while it was the lowest in the month of December (29.1 □). The normal monthly mean minimum temperature was the lowest in the month of January (14.6 □) as given in Figure 1.

"The research was arranged in split plot design and replicated thrice. There were fifteen combination of treatments, consisting five organic sources (vermiwash @ 10%, cowurine @ 10%, jeevamrutha @ 25%, biodigester filtrate @ 25% and urea @ 2%) in main plots and three stage of application (pre flowering, pod initiation and pre flowering + pod initiation) in sub plots. After the previous crop was harvested, the ground was ploughed once again, followed by two harrowing. The field was prepped to a good seedbed and the fields were set out in preparation for sowing. The variety JG-11 was used and fertilizer application was followed on the basis of the plant population occupied by crop. The full amount of fertilizer in the form of urea and di ammonium sulphate as per recommended package of practice 10:25:00 kg N, P_2O_5 and K_2O per ha was applied. The crop was sown on 24^{th} October 2020 with a spacing of 45 × 30 cm. The crop grown with the residual moisture of monsoon rains without any protective irrigations. Intercultivation was done to remove all weeds from the field in order to check crop weed competition. Harvesting was done at physiological maturity of the crop. The experimental area was harvested by cutting near to ground. After harvesting, the crop plants were tied together and dried under sun. The crop grain was threshed with wooden sticks after it had dried completely under the sun. The separated seeds were cleaned and grain and haulm yield were expressed in kilogram per hectare. Using the formula suggested by Donald (1962)" [9], the ratio of economic yield to biological yield was computed. Observations on the number of larval populations at pod development stage and percent pod damage were made on five randomly selected per meter row-length in each treatment at 3, 5, and 7 days intervals after each foliar spray. The data obtained were subjected to square root transformation ($\sqrt{(x+0.5)}$) and analyzed by following the analysis of variance technique. The economics of each treatment was computed with prevailing market prices of the corresponding year. The composite soil sample was collected at a depth of 0 to 15 cm before sowing from the experimental area and was analyzed for physicochemical properties. The soil was texturally clay, the alkaline in reaction (pH 8.32), with a salinity of (0.24 dSm^{-1}), low in available Nitrogen (168 kg N ha^{-1}), high in available Phosphorus (31 kg P_2O_5 ha^{-1}), and high in available Potassium (342 kg K_2O ha^{-1}). The procedure for the analysis was given by Jackson [10].

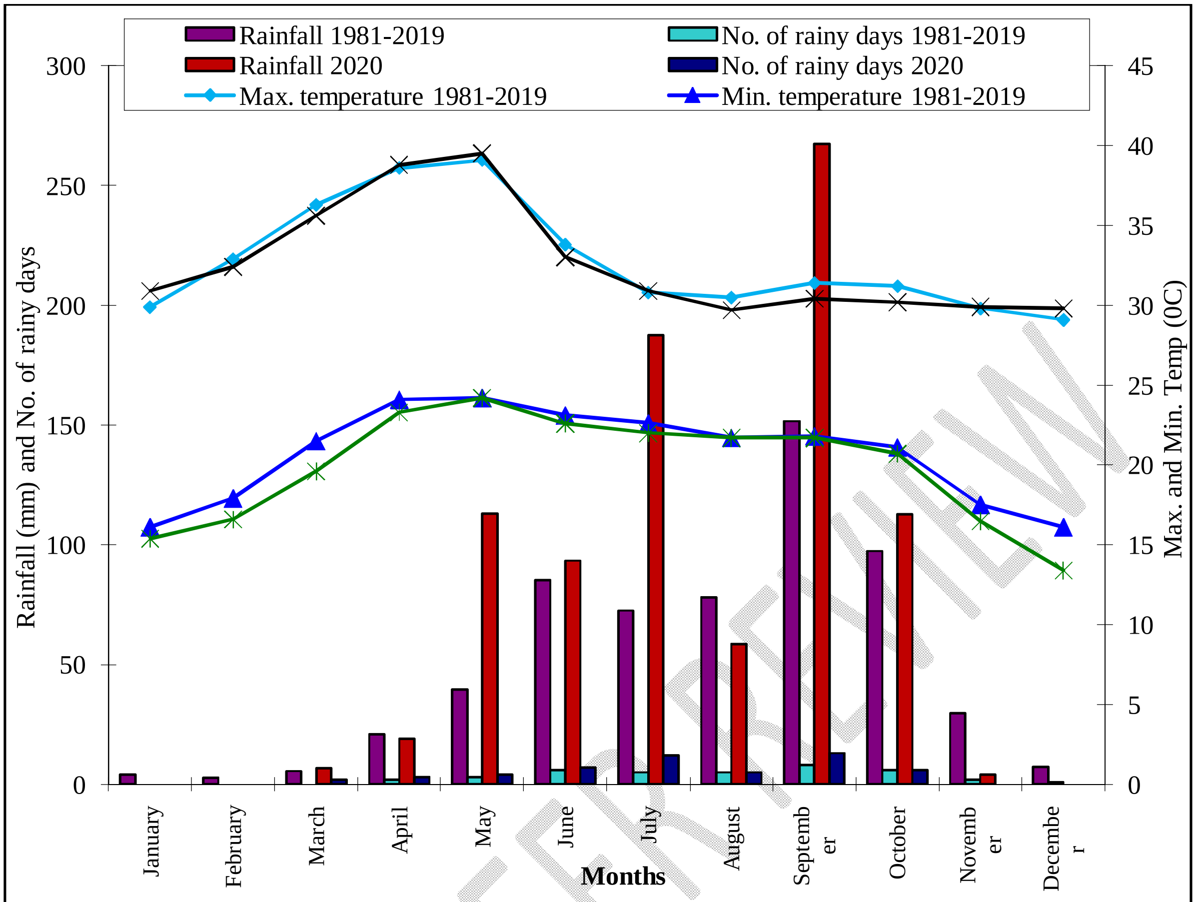

Figure 1: Monthly meteorological data for the experimental year (2020) against normal for 39 years (1981-2019) at RARS, Vijayapura (Karnataka)

2.1 Statistical analysis

The data collected from the experiment at different growth stages and at harvest were subjected to statistical analysis as described by Gomez and Gomez (1984) [11]. The level of significance used for 'F' and 't' tests was P=0.05. Critical Difference (CD) values were calculated at 5 percent probability level if the F test will find to be significant.

3. RESULTS AND DISCUSSION

3.1 Growth attributes

The leaf, stem, and reproductive parts oven dry weight at peak flowering stage showed significantly higher with the foliar application of jeevamrutha @ 25% both at pre-flowering and at pod initiation (3.20, 3.11 and 0.97 g plant^{-1}, respectively) and the lowest plant dry weight was noticed under application of biodigester filtrate @ 25% (2.09, 1.72 and 0.50 g plant^{-1}, respectively) (Table 1). Similar results was reported by Patil et al. [12]. Dry matter accumulation is the sum total effect of the overall growth of the plant like plant height, nodule count and leaf area indicating higher chlorophyllic area with improved photosynthetic efficiency of the plants which in turn resulted in higher dry matter accumulation, and also pods and grains inside the pods contribute to dry matter accumulation.

Higher chlorophyll content (SPAD values) in the leaves of chickpeas is an indication of the higher photosynthetic efficacy of the plant. Foliar application at both pre-flowering and pod initiation recorded higher SPAD values as compared to the alone application either at pre-flowering or at pod initiation among different stages of application. These results are in conformity with the findings of Nekar *et al.* [13].

Table 1: SPAD value and dry matter accumulation in different parts of chickpea at peak flowering stage as influenced by foliar spray of different organic sources, stage of the application and their interactions

Treatments	Dry matter accumulation (g plant^{-1})			SPAD values
	Leaves	Stem	Reproductive parts	
Organic sources (M)				
M_1 : Vermiwash @ 10%	2.53	2.17	0.60	48.84
M_2 : Cow urine @ 10%	2.58	2.38	0.73	48.91
M_3 : Jeevamrutha @ 25%	2.94	2.52	0.81	49.17
M_4 : Bio digesters filtrate @ 25%	2.43	2.01	0.58	48.78
M_5 : Urea @ 2%	2.59	2.12	0.79	48.92
S.Em ±	0.07	0.06	0.02	0.06
CD at 5 %	0.22	0.19	0.08	0.20
Stage of application (S)				
S_1 : Pre flowering	2.31	1.89	0.56	48.65
S_2 : Pod initiation	2.61	2.25	0.72	48.64
S_3 : Pre-flowering and Pod initiation	2.92	2.58	0.83	49.48
S.Em ±	0.03	0.04	0.01	0.03
CD at 5 %	0.10	0.13	0.03	0.10
Interactions (M×S)				
$M_1 S_1$	2.15	1.57	0.44	48.50
$M_1 S_2$	2.49	2.73	0.62	48.84
$M_1 S_3$	2.94	2.21	0.76	49.19
$M_2 S_1$	2.10	1.94	0.61	48.45
$M_2 S_2$	2.64	2.21	0.70	48.99
$M_2 S_3$	3.01	2.99	0.90	49.27
$M_3 S_1$	2.62	2.18	0.51	48.97
$M_3 S_2$	3.00	2.26	0.94	49.25
$M_3 S_3$	3.20	3.11	0.97	49.29
$M_4 S_1$	2.09	1.72	0.50	48.44
$M_4 S_2$	2.34	1.93	0.55	48.69
$M_4 S_3$	2.86	2.38	0.69	49.21
$M_5 S_1$	2.58	2.05	0.75	48.87
$M_5 S_2$	2.58	2.12	0.78	48.93
$M_5 S_3$	2.61	2.19	0.83	48.96
S.Em ±	0.09	0.10	0.03	0.09
CD at 5 %	0.29	0.30	0.10	0.27

3.2 Yield attributes

A significantly higher number of pods per plant (46.53), grain weight per plant (9.45 g), and higher harvest index (42.66 %) were recorded at harvest (Figure 2). Similar results were also reported by Sudhanshu *et al.* [14]. The increase in pods per plant may be explained due to an increase in the number of branches under higher nutrient application at different growth stages. With the application of higher rates of fertilizer and foliar nutrition, the tissue differentiations from the somatic to reproductive, meristematic activity, and the development of floral primordia might have been enhanced causing greater production of flowers which later developed to pod [15]. Jeevamrutha @ 25% applied at both pre-flowering and at pod initiation recorded a 17.89% increase in grain yield per hectare as compared to urea @ 2% application at both stages

Correlation studies also support this view (Figure 3). The results clearly indicated a positive and significant correlation between grain yield with yield components and growth attribute *viz.,* number of branches per plant ($r=0.790^{**}$), total dry matter ($r=0.849^{**}$), number of pods per plant ($r=0.858^{**}$), grain weight per plant ($r=0.857^{**}$), hundred seed weight ($r=0.839^{**}$) and haulm yield per hectare ($r=0.989^{**}$).

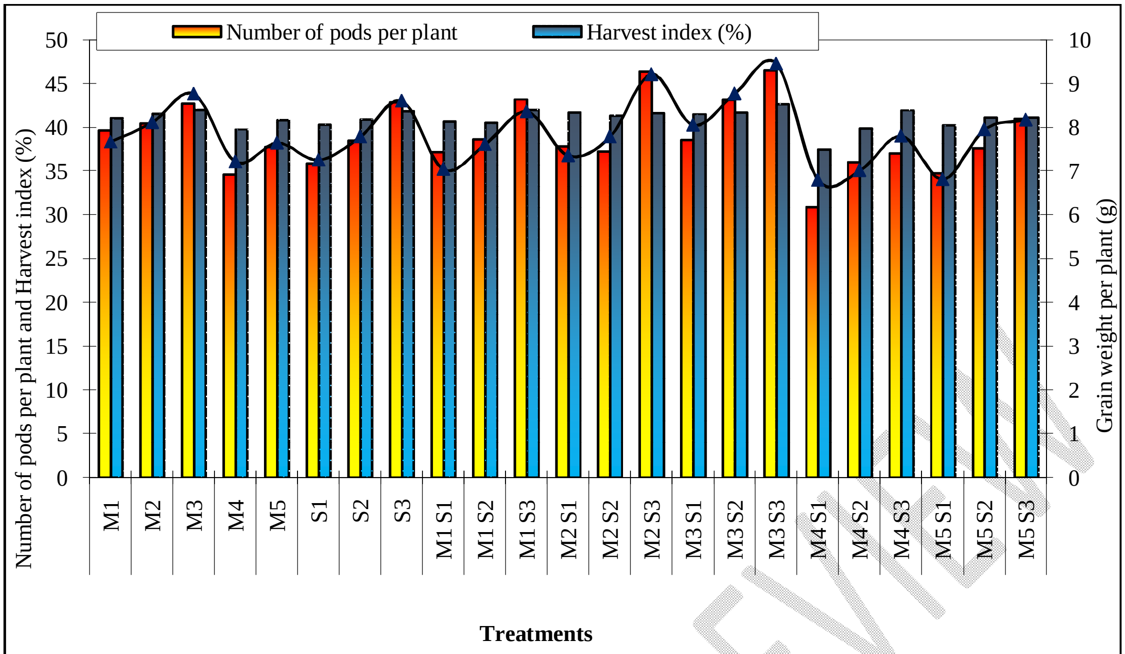

Figure 2: Number of pods per plant, grain weight per plant, and harvest index of chickpea as influenced by different organic sources and stage of the application

Note: M_1: Vermiwash @ 10%, M_2: Cow urine @ 10%, M_3: Jeevamrutha @ 25%, M_4: Bio digester filtrate @ 25%, M_5: Urea @ 2%, S_1: Pre flowering, S_2: Pod initiation, S_3: Pre flowering and Pod initiation

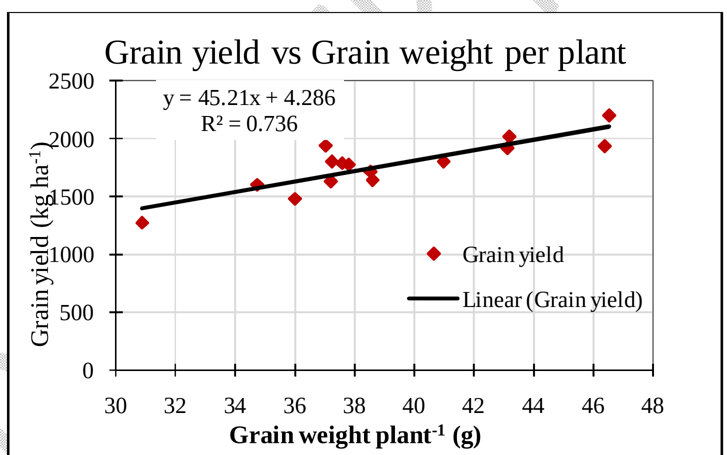

Figure 3a. Association between grain yield per hectare with grain weight per plant in chickpea

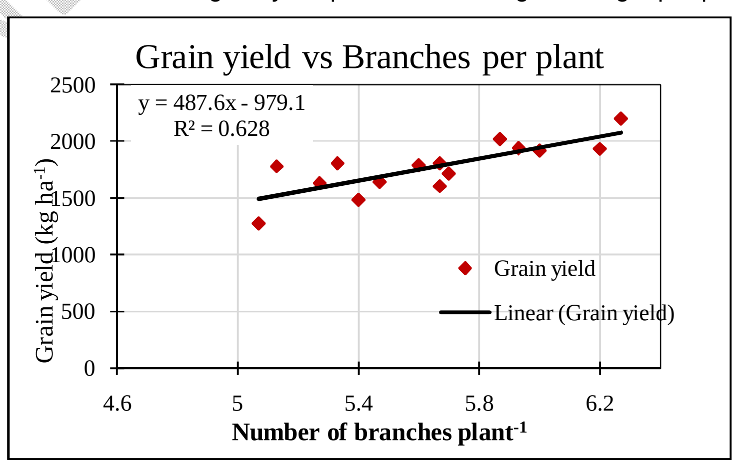

Figure 3b. Association between grain yield per hectare with number of branches per plant in chickpea

3.3 Soil enzyme activity and quality parameters

Soil enzymatic activities (dehydrogenase) are the indication of the improved biological property of soil, an increase in biological activities helps in better mineralization and solubilization of nutrients in the soil. The study indicated dehydrogenase activity was found non-significantly at the pod development stage (Table 2). The greater dehydrogenase activity (6.17 µg TPF g^{-1} of soil day^{-1}) was found with treatment receiving foliar spray of jeevamrutha @ 25% both at pre-flowering and at pod initiation stage among other treatments.

The protein content in the seed and protein yield per hectare are an indication of the nutritive quality of chickpeas (Table 2). No variation in protein content was found due to the application of treatments. But, the protein yield with foliar spray of jeevamrutha @ 25% was recorded as significantly higher (422 kg ha^{-1}) due to higher seed yield regardless of the variation in protein content [16]. Among the interactions, foliar application of jeevamrutha @ 25% both at pre-flowering and at pod initiation recorded a significantly higher protein yield (490 kg ha^{-1}) due to the higher seed yield of chickpea over other treatment combinations.

Table 2: Dehydrogenase activity at the pod development stage, protein content, and protein yield at harvest of chickpea as influenced by foliar spray of different organic sources, stage of the application and their interactions

Treatments	Dehydrogenase activity (µg TPF/g of soil/day)	Protein content (%)	Protein yield (kg ha^{-1})
Organic sources (M)			
M_1 : Vermiwash @ 10%	5.54	21.12	372
M_2 : Cow urine @ 10%	5.80	21.25	391
M_3 : Jeevamrutha @ 25%	5.98	21.32	422
M_4 : Bio digesters filtrate @ 25%	5.53	20.97	331
M_5 : Urea @ 2%	5.21	21.09	367
S.Em ±	0.16	0.29	15
CD at 5 %	NS	NS	48
Stage of application (S)			
S_1 : Pre flowering	5.53	20.91	337
S_2 : Pod initiation	5.54	21.14	367
S_3 : Pre flowering and Pod initiation	5.77	21.38	426
S.Em ±	0.10	0.27	8
CD at 5 %	NS	NS	24
Interactions (M×S)			
$M_1 S_1$	5.65	20.84	338
$M_1 S_2$	5.40	21.00	346
$M_1 S_3$	5.56	21.50	433
$M_2 S_1$	5.72	21.13	377
$M_2 S_2$	5.76	21.25	384
$M_2 S_3$	5.92	21.31	414
$M_3 S_1$	5.87	21.09	359
$M_3 S_2$	5.91	21.37	417
$M_3 S_3$	6.17	21.51	490
$M_4 S_1$	5.24	20.67	268
$M_4 S_2$	5.50	20.92	310
$M_4 S_3$	5.87	21.31	415
$M_5 S_1$	5.15	20.85	342
$M_5 S_2$	5.12	21.15	378
$M_5 S_3$	5.35	21.27	380
S.Em ±	0.24	0.57	21
CD at 5 %	NS	NS	65

Note: NS – Non significant

3.4 Major nutrient uptake

The uptake of major nutrients *viz.,* nitrogen (39.49 kg ha^{-1}), phosphorous (6.53 kg ha^{-1}) and potassium (21.54 kg ha^{-1}) was significantly higher in treatments receiving the foliar application of jeevamrutha @ 25% both at pre-flowering and at pod initiation over other organics alone or combinations (Figure 4). As chickpea is a leguminous crop that can fix atmospheric nitrogen biologically due to the presence of nodules [17]. A number of nodules (16.00) and nodule dry weight (0.84 g) showed a significant influence in contributing to the crop nutrient uptake. The results are in conformity with the correlation between N uptake with growth and yield parameters *viz.,* grain yield per hectare ($r=0.726^{**}$), total dry matter production ($r=0.936^{**}$), seed yield per plant ($r=0.917^{**}$), P uptake ($r=0.848^{**}$) and K uptake ($r=0.887^{**}$).

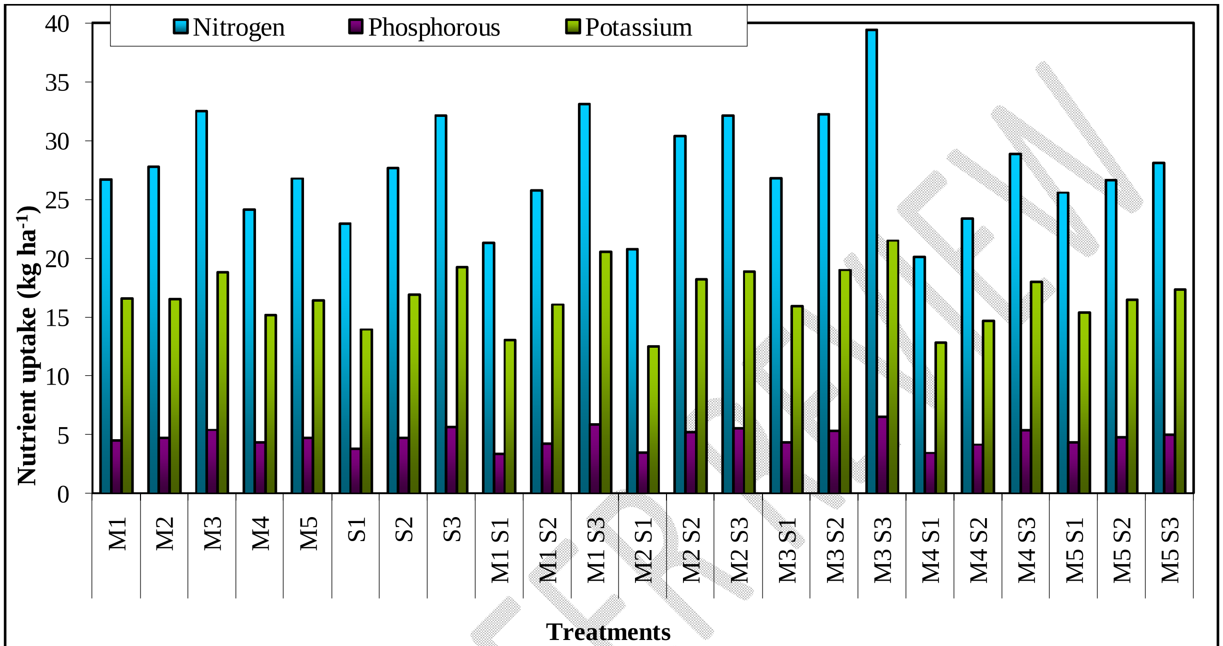

Figure 4: Nutrient uptake (NPK) (kg ha^{-1}) in chickpea at peak flowering stage as influenced by foliar spray of different organic sources, stage of application and their interactions

Note: M_1: Vermiwash @ 10%, M_2: Cow urine @ 10%, M_3: Jeevamrutha @ 25%, M_4: Bio digester filtrate @ 25%, M_5: Urea @ 2%, S_1: Pre flowering, S_2: Pod initiation, S_3: Pre flowering and Pod initiation

3.5 Effect on pest load

The results indicated that, prior to the treatment imposition, the number of *H. armigera* larvae per meter row length was uniform among all the treatments. Reduction in number of larvae on crop was meager in all the treatments applied either alone or at both stages except with urea application. However, the efficacy was accelerated on 3 days onwards due to organics application. The pooled results of 3 days and 7 days after treatment imposition resulted in significant reduction of *H. armigera* larvae per meter row in foliar application of cow urine @ 10% (2.21 larvae per meter row length) which was found on par to vermiwash @ 10% (2.23 larvae per meter row length) as compared to jeevamrutha @ 25% (2.35 larvae per meter row length) (Table 3). Further, the next best treatment was biodigester filtrate @ 25% (2.32 larvae per meter row length) and treatment receiving urea @ 2% recorded highest larval population (2.93 larvae per meter row length) as it does not contain any pesticidal properties rather improve the growth attributes. Foliar spray of vermiwash provides mild resistance against pest to the growing plant for elongation, early flowering and fruiting phase and also bio-pesticide exhibits a synergistic effect with vermiwash to control pest population and for better productivity in pea [18].

The results pertaining to efficacy of treatments at various stages of application of organics had shown that, spraying at pre-flowering and pod initiation stages recorded significantly lesser larval population with just 2.22 larvae per meter row length as compared to single spray either at pre-flowering (2.58) and pod initiation stage (2.43). The interaction effects studies showed a significantly lesser larval population in cow urine @ 10% when sprayed both at pre-flowering and at pod initiation with only 2.01 larvae per meter row length which was far better than other interactions but, it was found to be on par with vermiwash @ 10% and biodigester filtrate @ 25% each when sprayed at both pre-flowering and at pod initiation stage (2.02 and 1.97). Sridevi et al. [19] reported that, natural concoctions contain plant growth-promoting bacteria (*P. flourescens*), rhizosphere fungi

(*Trichoderma* spp.), and endophytic fungi (*M. anisopliae* and *B. bassiana*) found in natural products and concoctions could act as plant biostimulants. This could be the reason for the increased vigor and disease resistance in plants. Among all the organics cow urine 10% was found to be superior to all other treatments imposed and it also showed a higher efficacy in reducing the pod damage (%) not only in interaction effect but also at both pre flowering and at pod initiation stages of imposition.

Table 3: Observation on pest load of chickpea at pod development stage and pod damage (%) after harvest as influenced by foliar spray of different organic sources, stage of application and their interactions

Treatments	No. of larvae meter row^{-1} *				Pod Damage % **
	Pre count	3 DAT	7 DAT	Pooled data	
Organic sources (M)					
M_1 : Vermiwash @ 10%	2.61 (1.76)	2.22 (1.65)	1.87 (1.53)	2.23 (1.65)	7.87 (16.30)
M_2 : Cow urine @ 10%	2.59 (1.76)	2.19 (1.64)	1.84 (1.53)	2.21 (1.65)	7.78 (16.18)
M_3 : Jeevamrutha @ 25%	2.56 (1.75)	2.44 (1.71)	2.06 (1.60)	2.35 (1.69)	8.67 (17.13)
M_4 : Bio digesters filtrate @ 25%	2.63 (1.77)	2.37 (1.69)	1.99 (1.58)	2.32 (1.68)	8.57 (17.02)
M_5 : Urea @ 2%	2.63 (1.77)	2.87 (1.83)	3.27 (1.94)	2.93 (1.85)	9.82 (18.25)
S.Em ±	0.01	0.02	0.02	0.03	0.43
CD at 5 %	NS	0.06	0.06	0.10	NS
Stage of application (S)					
S_1 : Pre flowering	2.65 (1.77)	2.66 (1.78)	2.42 (1.70)	2.58 (1.75)	8.63 (17.07)
S_2 : Pod initiation	2.56 (1.75)	2.46 (1.72)	2.25 (1.65)	2.43 (1.71)	8.62 (17.06)
S_3 : Pre-flowering and Pod initiation	2.60 (1.76)	2.12 (1.62)	1.95 (1.55)	2.22 (1.65)	8.37 (16.80)
S.Em ±	0.01	0.01	0.01	0.03	0.14
CD at 5 %	NS	0.03	0.03	0.10	NS
Interactions (M×S)					
$M_1 S_1$	2.68 (1.78)	2.49 (1.73)	2.14 (1.62)	2.44 (1.71)	7.89 (16.32)
$M_1 S_2$	2.55 (1.75)	2.26 (1.66)	1.91 (1.55)	2.24 (1.66)	7.97 (16.40)
$M_1 S_3$	2.62 (1.76)	1.90 (1.55)	1.55 (1.43)	2.02 (1.59)	7.77 (16.18)
$M_2 S_1$	2.55 (1.75)	2.36 (1.69)	2.01 (1.59)	2.31 (1.68)	7.90 (16.33)
$M_2 S_2$	2.58 (1.76)	2.33 (1.68)	1.98 (1.57)	2.30 (1.67)	7.87 (16.25)
$M_2 S_3$	2.63 (1.77)	1.88 (1.54)	1.53 (1.43)	2.01 (1.58)	7.56 (15.94)
$M_3 S_1$	2.65 (1.78)	2.72 (1.79)	2.37 (1.69)	2.58 (1.75)	8.70 (17.16)
$M_3 S_2$	2.47 (1.72)	2.34 (1.68)	1.92 (1.56)	2.24 (1.66)	8.80 (17.26)
$M_3 S_3$	2.56 (1.75)	2.26 (1.66)	1.88 (1.54)	2.23 (1.65)	8.50 (16.95)
$M_4 S_1$	2.72 (1.79)	2.75 (1.80)	2.34 (1.69)	2.60 (1.76)	8.80 (17.26)
$M_4 S_2$	2.65 (1.77)	2.44 (1.72)	2.08 (1.61)	2.39 (1.70)	8.70 (17.16)
$M_4 S_3$	2.52 (1.74)	1.90 (1.55)	1.55 (1.43)	1.97 (1.57)	8.20 (16.64)

$M_5 S_1$	2.66 (1.78)	2.99 (1.87)	3.22 (1.93)	2.96 (1.86)	9.84 (18.27)
$M_5 S_2$	2.57 (1.75)	2.95 (1.86)	3.35 (1.96)	2.96 (1.86)	9.78 (18.22)
$M_5 S_3$	2.66 (1.78)	2.67 (1.78)	3.24 (1.93)	2.86 (1.83)	9.83 (18.27)
S.Em ±	0.02	0.03	0.03	0.07	0.50
CD at 5 %	NS	0.08	0.09	0.21	NS

Note: DAT – Days after treatment **NS** – Non significant
*Figures in parentheses are square root transformed values,
** Figures in parentheses are arc sine transformation.

4. CONCLUSION

Foliar application of liquid organic manures, either jeevamrutha @ 25% or cow urine @ 10% both at pre-flowering and at pod initiation stages helped to increase growth attributes and yield parameters, seed yield, nutrient uptake by the plants, quality characters, maximum net returns and benefit-cost ratio in chickpea. The application of organic concoctions also showed a significantly lesser larval population with cow urine @ 10% sprayed at both pre-flowering and pod initiation and it was on par with vermiwash @ 10% and biodigester filtrate @ 25% along with lesser percent pod damage as compared to other interactions.

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