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# Effect of organic formulations on growth and yield of cowpea (*Vigna unguiculata* L.)

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## Abstract
A field study was conducted to study the effect of organic formulations on growth and yield of cowpea (*Vigna unguiculata* L.) during *rabi* season of 2023-24 at Instructional Farm, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, College of Agriculture, Dapoli, Dist. Ratnagiri, Maharashtra. The experiment was laid out in randomized block design with three replications and consist nine treatments *viz*., $T_1$: absolute control, $T_2$: RDF, $T_3$: $T_2$ + Moringa leaf extract @ 10% foliar spray, $T_4$: $T_2$ + Karanj leaf extract @ 10% foliar spray, $T_5$: $T_2$ + Gliricidia leaf extract @ 10% foliar spray, $T_6$: $T_2$ + Lantana leaf extract @10% foliar spray, $T_7$: $T_2$ + (Neem cake + groundnut cake + PSB) @ 5% foliar spray, $T_8$: $T_2$ + (Biogas slurry + Jeevamrit + Cow urine) @ 5% foliar spray and $T_9$: $T_2$ + (Neem cake + groundnut cake + KMB) @ 5% foliar spray. The treatment RDF + (Biogas slurry + Jeevamrit + Cow urine) @ 5% foliar spray at 30 and 45 DAS recorded significantly maximum plant height (22.75 cm), number of functional leaves plant$^{-1}$ (12.53), number of branches plant$^{-1}$ (10.50) and dry matter accumulation plant$^{-1}$ (13.08 g) at harvest, and significantly higher grain yield (1207.93 kg ha$^{-1}$), stover yield (1776.93 kg ha$^{-1}$), biological yield (2984.86 kg ha$^{-1}$) and harvest index (40.47%) among the treatments. Thus, it can be concluded that for getting better growth and higher yield of cowpea crop, it should be fertilized with RDF + (Biogas slurry + Jeevamrit + Cow urine) @ 5% foliar spray at 30 and 45 DAS.

**Keywords:** Cowpea, organic fertilizers, growth, yield

## Introduction
Cowpea (*Vigna unguiculata* L.) commonly known as "Lobia" is a pulse, fodder and green manure crop is a member of the *Leguminoceae* (Fabaceae) family. It is also known as southern pea, black eye pea, crowder pea, coupe or frijole. It is referred to as the "hungry-season crop" given that it is the first crop to be harvested before the cereal crops are ready (Urgesa, 2023) [17]. Among the cowpea cultivar group, *unguiculata* is the most cultivated cowpea, among the members of the cultivar group (Horn *et al*., 2022) [7]. Cowpea grain is highly nutritious and contains about 22.8 - 28.9% protein with an average of 25.6%, carbohydrates (56.8%), fibre (3.9%), ash (3.20%) and fat (1.3%) (Weng *et al*., 2019) [19]. According to Islam *et al*., (2006) [8], all parts of the plant are used as food, which is nutritious, providing protein and vitamins.
It has been reported that India has been growing cowpea since prehistoric times. It is considered a minor pulse in India and is grown mostly in arid and semi-arid regions in areas of West UP, Delhi, Punjab, and Kerala, as well as a sizable portion of Rajasthan, Karnataka, Kerala, Tamil Nadu, Maharashtra, and Gujarat. Cowpeas cover approximately 12.5 million hectares (31 million acres) of land globally. Worldwide production stands at 3 million tonnes, and cowpeas are consumed by 200 million people daily. The cowpea market was valued at US$ 7.21 billion in 2023 and is projected to reach US$ 9.43 billion by 2028 with a CAGR of 5.50% (Anonymous, 2023) [1].
Conventional farming methods have become increasingly intense due to modern technology, which has a negative impact on the environment, human health, natural resources, and the agricultural production system's long-term viability (Mylonas *et al*., 2020) [11]. India's agriculture has already seen several setbacks, such as deteriorating soil, declining biodiversity, rising cultivation expenses, etc. The detrimental impacts on human health, such as disruption of the

hormonal, neurological, and immunological systems, are impeding the achievement of sustainable development goals, which include the eradication of poverty, hunger, and malnutrition (Paroda, 2017) [12]. Furthermore, worries about the possible health impacts of pesticide residues have often made it difficult to choose pesticide-free items. The best course of action in the place of chemical agriculture has been identified as the search for a superior substitute that has negligible or no negative impacts on the natural agroecosystem. Therefore, returning to nonchemical agriculture in conjunction with a sustainable crop production system in order to restore soil health has received a lot of traction recently (Duddigan *et al*., 2022 and Mishra, 2018) [5, 10].

Applying nutrients to the crop through the foliage in addition to the recommended dose of fertilizers (RDF), biofertilizer, and plant growth regulators (PGRs) at critical growth stages is a novel and easy way to increase pulse productivity by reducing obstacles during flowering and pod setting (Dodiya *et al*., 2024) [4]. Plants can get mineral nutrients more quickly via foliar treatment than from soil application (Shah *et al*., 2013) [14]. In comparison to synthetic substances, liquid organic manures and plant extracts are more affordable, measurable, easily accessible, highly specific, environmentally friendly, and safe for human consumption when used for plant nutrition and disease management. The benefit of using nutrients that are already present in the agroecosystem is that organic fertilizers, including compost sludge manure and leaf extract, require less energy to prepare. However, because they are more stable when bonded in organic materials, the mineral nutrients may be released into the environment or washed away more slowly (King and Torbert, 2007) [9].

## Materials and Methodology

The field experiment entitled "Effect of organic formulations on growth and yield of cowpea (*Vigna unguiculata* L.)" was conducted on plot No. 39 at the Agronomy farm, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli; Dist. Ratnagiri during *rabi* 2023-24. Geographically experimental plot (39) of agronomy farm, College of Agriculture, Dapoli. Which is situated at 17.15° north latitude and 73.18° east longitude having elevation of 240 m above the mean sea level. The soil of experimental plot was sandy loam in texture, slightly acidic in pH (5.48) and high in organic carbon content (11.16 g $kg^{-1}$). It was low in available nitrogen (210 kg $ha^{-1}$), medium in available phosphorus (11.45 kg $ha^{-1}$) and low in available potassium (226.35 kg $ha^{-1}$).

Randomized block design was used in the trial. The experiment consists of nine treatments (eight treatments of organic formulations and one as control) and three replications. Thus, there were total 27 treatments plots. The treatment consist of $T_1$: absolute control, $T_2$: 25:50:40 kg $ha^{-1}$ N; $P_2O_5$; $K_2O$ (Through organic sources), $T_3$: $T_2$ + Moringa leaf extract @ 10% foliar spray at 30 and 45 DAS, $T_4$: $T_2$ + Karanj leaf extract @ 10% foliar spray at 30 and 45 DAS, $T_5$: $T_2$ + Gliricidia leaf extract @ 10% foliar spray at 30 and 45 DAS, $T_6$: $T_2$ + Lantana leaf extract @ 10% foliar spray at 30 and 45 DAS, $T_7$: $T_2$ + (Neem cake + groundnut cake + PSB) @5%, $T_8$: $T_2$ + (Biogas slurry + Jeevamrit + Cow urine) @ 5% foliar spray at 30 and 45 DAS and $T_9$: $T_2$ + (Neem cake + Groundnut cake + KMB) @ 5% foliar spray at 30 and 45 DAS. The gross plot size was 4.2 m × 3.60 m, the net plot size was 3.6 m × 3.3 m and the cowpea seeds were sown at a spacing of 30 cm × 15 cm.

The RDF 25:50:40 kg $ha^{-1}$ ($N_2$: $P_2O_5$: $K_2O$) given through organic sources *i.e*., vermicompost, PDM potash (potash derived from molasses), Ecomil, organic fertilizers as per treatment. Full doses of vermicompost, ecomil, PDM potash were given at the time of sowing of cowpea. Different organic formulations were sprayed 30 and 45 days after sowing of cowpea. In each plot five plants were selected randomly and tagged for observations. Observations on growth, yield and yield attributing characters viz., plant heigh (cm), number of functional leaves $plant^{-1}$, number of branches $plant^{-1}$, dry matter accumulation $plant^{-1}$ (g), grain yield (kg $ha^{-1}$), stover yield (kg $ha^{-1}$), biological yield (kg $ha^{-1}$) and harvest index (%) recorded at harvest. Collected experimental data were analysed statistically by applying technique of analysis of variance as applicable in randomized block design.

## Results and Discussions

### 1. Growth and development

The data given in the Table 1 indicates that the plant height, number of functional leaves $plant^{-1}$, number of branches $plant^{-1}$, dry matter accumulation $plant^{-1}$ (g) were significantly influenced due to different organic formulations during the experiment. The treatment $T_8$ [$T_2$ + (Biogas slurry + Jeevamrit + Cow urine) @ 5% foliar spray at 30 DAS and 45 DAS] recorded significantly maximum plant height (22.75 cm), number of functional leaves $plant^{-1}$ (12.53), number of branches $plant^{-1}$ (10.50) and dry matter accumulation $plant^{-1}$ (13.08 g) at harvest. This might be due to cow urine's uric acid functions as a hormone and fertilizer, giving crops the nutrients they need for greater growth and development. The increment in all the growth and developmental characters might be due to higher microbial load and growth hormones in jeevamrit which might have enhanced the soil biomass thereby sustaining the availability and uptake of applied as well as native soil nutrients which ultimately resulted in better growth as reported by Boraiah *et al*., (2017) [3]. The above results are in line with Palekar (2006) [13], Vasanthkumar (2006) [18] and Devakumar *et al*., (2008) [6]. The superior growth attributes under the treatment $T_8$ [$T_2$ + (Biogas slurry + Jeevamrit + Cow urine) @ 5% foliar spray at 30 DAS and 45 DAS] indicated that the plants under this treatment were metabolically more active. The amount of surface area available for absorbing solar energy increases with the number of leaves. Consequently, increased solar energy interception resulted in an increase in photosynthate synthesis. Because of the increased number of branches and functioning leaves brought forth by better photosynthetic efficiency, the crop generated more source. The increased availability of major nutrients under treatment $T_8$ led to the production of more assimilates, which subsequently enhanced the number of functional leaves and the number of branches compared to other treatments.

### 2. Yield

The data given in the Table 1 indicates that the grain yield (kg $ha^{-1}$), stover yield (kg $ha^{-1}$) and biological yield (kg $ha^{-1}$) were significantly influenced due to different organic formulations during experiment. The treatment $T_8$ [$T_2$ + (Biogas slurry + Jeevamrit + Cow urine) @ 5% foliar spray at 30 DAS and 45 DAS] recorded significantly higher grain yield (1207.93 kg $ha^{-1}$), stover yield (1776.93 kg $ha^{-1}$), biological yield (2984.86 kg $ha^{-1}$) with maximum harvest index (40.47%). These results from the crop are might be due to receiving enough nutrients at various phases of growth, the presence of growth regulators in cow urine, jeevamrit, and biogas slurry, and improved food material translocation from the source to the sink, all of which contributed to a larger yield. The crop treated with $T_8$ [$T_2$ + (Biogas slurry + Jeevamrit + Cow urine) @ 5% foliar spray at

30 DAS and 45 DAS] showed higher physiological activity, as seen by noticeably greater growth parameter values, which improve source generation.

**Table 1:** Growth and yield of cowpea at harvest as influenced by different treatments

| Treatment | Plant height (cm) | Number of functional leaves plant$^{-1}$ | Number of branches plant$^{-1}$ | Dry matter accumulation plant$^{-1}$ (g) | Grain yield (kg ha$^{-1}$) | Stover yield (kg ha$^{-1}$) | Biological yield (kg ha$^{-1}$) | Harvest index (%) |
|---|---|---|---|---|---|---|---|---|
| $T_1$ | 18.03 | 7.73 | 6.33 | 6.57 | 470.24 | 1155.37 | 1625.61 | 28.91 |
| $T_2$ | 18.20 | 8.53 | 7.47 | 9.37 | 744.43 | 1486.83 | 2231.27 | 33.50 |
| $T_3$ | 18.92 | 10.07 | 8.85 | 10.28 | 985.34 | 1643.57 | 2628.90 | 37.55 |
| $T_4$ | 18.73 | 9.13 | 7.87 | 9.32 | 861.14 | 1568.77 | 2429.91 | 35.43 |
| $T_5$ | 18.84 | 9.73 | 8.85 | 10.25 | 984.67 | 1577.17 | 2561.83 | 38.53 |
| $T_6$ | 18.77 | 9.40 | 8.40 | 9.92 | 922.25 | 1496.55 | 2418.80 | 38.23 |
| $T_7$ | 19.45 | 10.93 | 9.53 | 11.48 | 988.54 | 1670.01 | 2658.55 | 37.25 |
| $T_8$ | 22.75 | 12.53 | 10.50 | 13.08 | 1207.93 | 1776.93 | 2984.86 | 40.47 |
| $T_9$ | 20.84 | 11.07 | 9.93 | 12.55 | 1163.46 | 1708.08 | 2871.54 | 40.41 |
| S.Em. (±) | 0.62 | 0.59 | 0.48 | 0.48 | 56.31 | 83.42 | 84.63 | - |
| C.D. at 5% | 1.86 | 1.77 | 1.45 | 1.44 | 168.80 | 250.10 | 253.73 | - |

Higher biological production has been further produced by the proportionately greater sink in the form of grain and stover yield that has resulted from the enhanced source availability under $T_8$. These findings are in line with Singh *et al*., (2007) [15], Awasarmal *et al*., (2015) [2] and Somalraju *et al*., (2021) [16] who reported that increased nutrient supply led to higher production and translocation of assimilates to the sink, resulting in improved yield attributes and subsequently better grain yield.

## Conclusion

Based on the results of experiment, it can be concluded that for getting better growth and higher yield of cowpea crop, it should be fertilized with RDF + (Biogas slurry + Jeevamrit + Cow urine) @ 5% foliar spray at 30 and 45 DAS.

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