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Effect of spraying *Lantana* Fermented Extract on Growth and Yield of Green Gram (*Vigna radiata* L.) in Pots

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A B S T R A C T

Pot culture evaluation revealed that there was a significant increase in all growth parameters of green gram due to spraying with the Lanatna fermented extract (LFE) when compared with both unfermented as well as naturally fermented extracts. Between the two isolates of Lactic acid bacteria used for fermentation, DB 27 resulted in the highest values in all parameters. Its spraying twice @ 10 ml per L was the best treatment resulting in the highest values. It increased chlorophyll content by about 40 per cent at 45 DAS. Spraying green gram seedlings with LFE significantly increased pod and grain yield. The highest grain yield was obtained by spraying twice with Lantana extract, fermented with DB 27 (@ 10 ml per L). Thus, the present investigation has clearly brought out the potential of LFE in augmenting growth and yield attributes in green gram.

Introduction

Green gram is one of the main pulse crops in India. The important states producing this pulse are Madhya Pradesh, Maharashtra, Uttar Pradesh, Punjab, Andhra Pradesh, Rajasthan, Karnataka and Tamil Nadu. In 2013, the United Nations has declared 2016 as the international year of pulses (IYP 2016) (http://www.ipga.co.in). The IYP 2016 promises to be a milestone development in global pulse trade aiming to focus on the role of pulses in achieving food security and nutrition. The IYP program envisages for better utilization of pulse based proteins, to increase pulse production worldwide through different approaches as well as to improve trade in pulses. Any attempt to increase the pulse productivity is welcome.

Lantana camara L. is listed as one of the important medicinal plants of the world. *L. camara* is the most widespread species of this genus, growing luxuriantly at elevations up to 2000 m in tropical, subtropical and temperate regions. It is an evergreen aromatic shrub and planted as an ornamental plant around houses. It has four typical colors: yellow-orange, pink violet, yellow and white flower types. It is among the top ten invasive weeds on earth

(Sharma *et al.,* 2005). Species of the genus *Lantana* have been used in several applications in folk medicine. Many studies have reported that *L. camara* is a rich source of many bioactive molecules, and the phytochemical studies have resulted in the isolation of many triterpenes, steroids and flavonoids (Begum *et al.,* 2008). Often, weeds are seen as a problem rather than beneficial to the land. Many weeds and herbs are known to be mineral accumulators and are very important to the ongoing health of the soil.

Fermentation with microorganisms is known to yield high value products from raw or low grade substrates. Fermentation breaks down or converts the undesirable substrates into compatible components mediated by microbial enzymes, thereby improving the substrate properties via the production and enrichment of bioactive compounds (Parvez *et al.,* 2006). Fermentation mediated bio-activation of the herbal medicines has resulted in improved therapeutic potencies and efficacies and decreased toxicities (Wu *et al.,* 2013). It has been shown that during the course of *Lactobacillus* mediated fermentations, organic acids were released, proteins hydrolyzed and anti-oxidant ferulic acid from plant cell wall materials solubilized (Cheigh *et al.,* 1994). It has been reported that fermentation of *Anoectochilus formosanus* using *Lactobacillus acidophilus* boosted its anti-oxidant activity by increasing the total phenol content (Ng *et al.,* 2011). In another study, fermentation was used to enhance the antimicrobial potential of the crude herbal extract of *Phyllanthus niruri*. Fermentation was carried out using *Lactobacillus acidophilus*. The results indicated that the antimicrobial potential of the fermented herb was increased by about 80 per cent to 170 per cent when compared to the crude herbal extract (Venugopalan *et al.,* 2010). Thus, fermentation of any biomass is known to release nutrients, amino acids, phenolic phytochemicals and phytohormones. Hence, an attempt was made to ferment the biomass of *Lantana* weed using lactic acid bacterial (LAB) isolates and to study the effect of the fermented products on the growth and yield of green gram under pot cultures.

Materials and Methods

A pot experiment was conducted in the green house of the Department of Agricultural Microbiology, University of Agricultural Sciences, Dharwad, Karnataka, India. It was laid out in a Completely Randomized Design (CRD) with 14 treatments and 7 replications.

Treatment details

T_1 -T (JH) fermented extract, Spraying once @ 5 ml/l (30 DAS)

T_2 -T (JH) fermented extract, Spraying once @ 10 ml/l (30 DAS)

T_3 -T (JH) fermented extract, Spraying twice @ 5 ml/l (30 and 45 DAS)

T_4 -T (JH) fermented extract, Spraying twice @ 10 ml/l (30 and 45 DAS)

T_5 -DB 27 fermented extract, Spraying once @ 5 ml/l (30 DAS)

T_6 - DB 27 fermented extract, Spraying once @10 ml/l (30 DAS)

T_7 -DB 27 fermented extract, Spraying twice @ 5 ml/l (30 and 45 DAS)

T_8 -DB 27 fermented extract, Spraying twice @ 10 ml/l (30 and 45 DAS)

T_9 - Water extract (natural fermented), Spraying once @ 5 ml/l (30 DAS)

T_{10} -Water extract (natural fermented), Spraying once @ 10 ml/l (30 DAS)

T_{11} -Water extract (natural fermented), Spraying twice @ 5 ml/l (30 and 45 DAS)

T_{12} - Water extract (natural fermented), Spraying twice @ 10 ml/l (30 and 45 DAS)

T_{13} - Spraying Panchagavya as per POP (30 DAS)

T_{14} - Check (no spraying at all).

Green gram seeds of variety IPM 2-14 were soaked in the optimized concentration of the lactic acid bacterial fermented extract for 10 min. The seeds were treated with the *Rhizobium* biofertilizer and sown in pots. After germination, thinning was done to retain three plants in each pot.

The application of the recommended dose of FYM and N: P: S fertilizers as well as plant protection measures were taken up as per the recommended package of practices. Plant height, number of leaves per plant, chlorophyll content and dry matter production were measured at 45 days after sowing (DAS). Yield and yield components were measured after harvest of the crop.

Results and Discussion

The *Lantana* extract (30%) was prepared and subjected to fermentation using two selected lactic acid bacterial (LAB) isolates separately *viz*., T9JH) and DB 27, for five days and the fermented extract filtered (Tanuja, 2017). This filtrate was used for spraying in the pot experiment.

The influence of spraying the Lantana Fermented Extract (LFE) at different concentrations and different number of times on growth parameters of green gram was studied in pots. In general, there was a significant increase in all the growth parameters *viz.*, plant height, number of leaves and dry matter production due to spraying with the fermented extracts when compared with both unfermented extract as well as naturally fermented extracts (Table 1). Again, between the two isolates, DB 27 resulted in the highest values in all the parameters. And, spraying twice @ 10 ml/l was the best treatment yielding the highest values. It increased cholorophyll content by about 10 to 12 per cent at 30 DAS and up to 40 per cent at 45 DAS. LFE fermented with DB-27 isolate is enriched with phytohormones, NPK nutrients and other phytochemicals (Tanuja, 2017). All these constituents would have resulted in enhanced growth parameters and chlorophyll content as well.

Lantana fermented extracts can be considered as biostimulants. Biostimulants are extracts obtained from organic raw materials containing bioactive compounds.

The chief components of the biostimulants include mineral elements, humic acids and protein hydrolysates (Hamza and Suggars, 2001; Kauffman *et al.,* 2007).

Biostimulants are known to act at low concentrations (Zhang and Schmidt, 1999). The effect of a biostimulant depends on environmental factors, and on the dose and time of application (Kunicki *et al.,* 2010).

Application of biostimulants is known to increase the color of leaves by stimulating the chlorophyll content. This effect was observed in cowpea seeds pre-soaked in carrot extract (Abbas and Akladious, 2013).

Chlorophyll levels were increased and carotenoids were doubled in Rocket vegetable (*Eruca sativa*) when treated with *Moringa oleifera* extract (Abdalla, 2013). High concentration of leaf pigments resulting from biostimulant treatments in rocket has also been observed by Vernieri *et al.,* (2006).

Table.1 Effect of *Lantana* fermented extract on growth parameters and chlorophyll content of green gram in pots (45 DAS)

Treatment	Plant height (cm/ plant)	No. of leaves per plant	Dry matter accumulation (g /plant)	Chlorophyll content (SPAD value per plant)
T_1 - (T(JH) LFE spraying once @ 5 ml/l)	22.07	16.37	0.73	48.5
T_2 - (T(JH) LFE spraying once @ 10 ml/l)	24.75	21.00	0.75	48.7
T_3 - (T(JH) LFE spraying twice @ 5 ml/l)	26.00	22.75	0.77	51.2
T_4 - (T(JH) LFE spraying twice @ 10 ml/l)	27.25	23.75	0.79	51.7
T_5 - (DB-27 LFE spraying once @ 5 ml/l)	26.17	21.65	0.80	53.7
T_6 - (DB-27 LFE spraying once @ 10 ml/l)	26.75	22.52	0.82	54.2
T_7 - (DB-27 LFE spraying twice @ 5 ml/l)	27.80	24.57	0.84	56.1
T_8 - (DB-27 LFE spraying twice @ 10 ml/l)	30.02	25.27	0.86	58.2
T_9 - (NFE spraying once @ 5 ml/l)	17.25	15.30	0.61	45.1
T_{10} - (NFE spraying once @ 10 ml/l)	20.25	18.37	0.63	45.4
T_{11} - (NFE spraying twice @ 5 ml/l)	22.70	22.37	0.64	45.7
T_{12} - (NFE spraying twice @ 10 ml/l)	24.25	22.87	0.66	46.3
T_{13} - Spraying panchagavya	21.25	19.17	0.54	43.7
T_{14} – Check	17.12	15.37	0.52	41.3
S. Em. ±	0.37	0.31	0.01	0.67
C.D. at 1%	1.41	1.21	0.04	2.57

Note: DAS - days after sowing
LFE - *Lantana* fermented extract
NFE - Natural fermented extract

Table.2 Effect of *Lantana* fermented extracts on yield and Yield components of green gram at harvest

Treatment	No of pods per plant	Pod weight (g/plant)	No of seeds per pod	Grain yield (g/plant)
T_1 - (T(JH) LFE spraying once @ 5 ml/l)	16.67	9.21	9.67	5.68 (25.3)
T_2 - (T(JH) LFE spraying once @ 10 ml/l)	17.33	9.67	10.33	6.65 (46.7)
T_3 - (T(JH) LFE spraying twice @ 5 ml/l)	18.33	9.93	10.67	7.03 (55.1)
T_4 - (T(JH) LFE spraying twice @ 10 ml/l)	19.33	10.29	11.00	8.18 (80.5)
T_5 - (DB-27 LFE spraying once @ 5 ml/l)	20.33	10.57	10.67	7.83 (72.8)
T_6 - (DB-27 LFE spraying once @ 10 ml/l)	21.33	10.87	11.33	9.04 (99.5)
T_7 - (DB-27 LFE spraying twice @ 5 ml/l)	22.33	11.01	11.67	9.47 (109.0)
T_8 - (DB-27 LFE spraying twice @ 10 ml/l)	23.00	11.17	12.00	10.58 (133.5)
T_9 - (NFE spraying once @ 5 ml/l)	15.00	9.13	9.67	5.26 (16.1)
T_{10} - (NFE spraying once @ 10 ml/l)	16.00	9.20	10.00	6.24 (37.7)
T_{11} - (NFE spraying twice @ 5 ml/l)	16.67	9.66	10.33	6.64 (46.5)
T_{12} - (NFE spraying twice @ 10 ml/l)	17.33	9.90	10.67	4.92 (47.4)
T_{13} - Spraying panchagavya	14.33	8.70	9.33	4.53 (8.6)
T_{14} – Check	13.33	8.61	9.00	5.68
S. Em. ±	0.267	0.24	0.285	0.16
C.D. at 1%	1.05	0.97	1.120	0.63

Note: DAS - days after sowing
LFE - *Lantana* fermented extract
NFE - Natural fermented extract
Values in parantheses indicate per cent increase values over the control

Flavonoids are secondary metabolites of plants with polyphenolic structure. They are synthesized by the polypropanoid pathway and the startup component is phenylalanine molecule.

They constitute a wide range of substances that play an important role in protecting biological systems against the harmful effects of oxidative processes on macromolecules, such as carbohydrates, proteins, lipids and DNA (Halliwell and Gutteridge, 1989).

Recently, phenolics and flavonoids have been considered as great antioxidants and proved to be more effective than vitamin C, E and carotenoids (Dai and Mumper, 2010). Phenols are also known to modify the endogenous levels of phytohormones (Kefeli and Dashek, 1984) which thereby influence various plant processes leading to improved yield and quality of seeds.

Foliar spraying of *Brassica juncea* with phenolic compounds, namely RD brown and resorcinol (200µg ml^{-1} each) modified canopy structure of plants by increasing primary, secondary and tertiary branching (Setia *et al.*, 1991).

The seed yield per plant was also increased greatly mainly due to significant increase in number of inflorescences and siliquae per plant, 100 seed weight and number of seeds per siliqua with these treatments.

A perusal of Table 2 indicated that spraying green gram seedlings with LFE significantly increased pod and grain yield.

The highest grain yield was obtained with the spraying of LFE, fermented with DB 27, sprayed twice @ 10 ml/l. This may be attributed to the fact that the LFE is rich in NPK plant nutrients, phytohormones and other phytochemicals. The LFE, when sprayed, stimulated microbial activities and, in turn, the soil enzymatic activities (Tanuja, 2017). All these would have ultimately reflected on the increased seed germination, growth and yield attributes of green gram. Biostimulants are known to act directly on the plant physiology and metabolism or indirectly by improving the soil conditions (Nardi *et al.*, 2009). Biostimulants in soils improve the microflora and, thus, provide positive influence on plant growth.

These products are usually applied in addition to standard fertilization treatments to improve the nutrient use efficiency and products quality (Heckman, 1994).

Thus, the findings of the preset investigation have clearly brought the potential of LFE in augmenting growth and yield attributes in green gram.

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