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Suma C Kammar
Department of Agriculture Microbiology, UAS, Raichur, Karnataka, India

Mahadeva Swamy
Department of Agriculture Microbiology, UAS, Raichur, Karnataka, India

Ravindra C Gundappagol
Department of Agriculture Microbiology, UAS, Raichur, Karnataka, India

Nagaraj M Naik
Department of Agriculture Microbiology, UAS, Raichur, Karnataka, India

BK Desai
Department of Agronomy, UAS, Raichur, Karnataka, India

Amaresh YS
Department of Plant Pathology, UAS, Raichur, Karnataka, India

Corresponding Author:
Suma C Kammar
Department of Agriculture Microbiology, UAS, Raichur, Karnataka, India

Isolation of endophytic bacteria and its effect on growth parameters of chilli (*Capsicum annum*)

Suma C Kammar, Mahadeva Swamy, Ravindra C Gundappagol, Nagaraj M Naik, BK Desai and Amaresh YS

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Abstract
The present investigation was carried out in the glass house of Department of Agricultural Microbiology, University of Agricultural Sciences, Raichur during 2019 to study the effect of endophytic isolates on growth parameters of chilli. The treatment was laid out in Completely Randomized Design (CRD) with eighteen treatments and three replications. Results indicated that the consortium of endophytic bacteria (ESK-26 + ESR-6) had performed well in pot trial and significantly enhanced growth parameter as compare to control. Significantly highest plant height, number of leaves per plant, number of branches per plant, root length, shoot dry weight, root dry weight and total dry weight were recorded by the treatment T_8 (ESK-26 + ESR-6) at 30, 60 and 90 DAS.

Keywords: Endophytic bacteria, chilli

Introduction
Low cost, eco-friendly and sustainable means of achieving agricultural intensification and improving productivity is by adopting the use of microbial inoculants to enhance the availability and use of vital soil nutrients (Jambon *et al*., 2018) [6]. Microbes with tremendous capacities of PGPR, biocontrol and abiotic stress alleviation are being explored in rhizosphere, endosphere, phyllosphere and unique ecological niches (Abbamondi *et al.*, 2016) [1]. Endophytes have proven potential to be used in agriculture.

The term "endophyte" is derived from the Greek words "endon" meaning within, and "phyton" meaning plant. Endophytic microbes, residing in plant play a powerful role in exerting their beneficial attributes with a higher consistency, particularly they dwell in a relatively secure environment, largely protected from the externally induced abiotic or biotic stresses (Shatrupa *et al.*, 2018) [11]. Plants constitute vast and diverse niches for endophytic organisms. Nearly 300000 plant species that exist on the earth, each individual plant is host to one or more endophytes (Strobel *et al*., 1993) [13].

Endophytes need to initially enter the plant endosphere, adapt new environment and are able to penetrate and become systematically disseminated in the host plant. Actively colonizing the apoplast, conducting vessels and occasionally the intracellular spaces (Hallmann *et al.*, 1997) [5]. Root endophytes often colonize and penetrate the epidermis at sites of lateral root emergence, root hair zone and root cracks and residing within apoplastic space between plant cells (Schulz and Boyle, 2006) [10]. Cellulase and protease act as key enzymes for the invasion and colonization of plant roots (Susilowatim *et al*., 2015) [15].

Endophytic bacteria have been isolated from a large diversity of plants. Organisms like *Bacillus*, *Enterobacter*, *Klebsiella*, *Pseudomonas*, *Burkholderia*, *Pantoea*, *Agrobacterium*, *Methylobacterium* spp. Constitute the endophytes commonly isolated from diverse plants such as rice, wheat, maize, cotton, clover, potato, sugarcane, tomato, cucumber, and wild grasses (Bacon and Hinton, 2006) [3]. The precise role of endophytes in plants is not yet known. However, their capability to thrive within the host tissues away from microbial competition and environmental degradation has made endophytes potential candidates for use in agriculture.

In Karnataka, Chilli (*Capsicum annum* L.) and tomato (*Lycopersicon esculentum* Mill.) are two major transplanted crops, which belong to the family solanaceae which has 90 genera and 2000 species.

It is used in both green and dry forms as an ingredient in preparation of several spicy dishes. Chilli is native of Central America and is a well known spice crop due to the presence of 'Capsaicin' which imparts potency. It appears pink after ripening due to the pigment 'Capsanthin'. It is a rich source of ascorbic acid.

Chilli is grown over an area of 364 thousand hectares with the production of 37 million tonnes in India and the major chilli growing states in India are Andhra Pradesh, Karnataka, Tamil Nadu, Madhya Pradesh and West Bengal. Among them, in Karnataka, it is grown in 168 thousand hectares area with 52 thousand tonnes of yield (Anon, 2020) [2]. This study was conducted to isolate and evaluate bacterial endophytes for their plant growth promotion attribute.

Material and Methods

Isolation of endophytic microorganisms from leaf, stem and roots of chilli

The isolation of endophytes was carried out as per the standard procedures given by Bacon *et al*. (2002) [4]. The randomly selected plants were uprooted manually and washed in running tap water. Stem sections of 2 cm length were excised using flame sterilized scalpel from 1 cm to 2 cm above the soil line. The leaf and root sections were similarly prepared.

All the samples were blotted dry with filter paper and then weighed to have final sample of 0.5 gm. The surface sterilization of the stem, root and leaf pieces were carried out with the following immersion sequence: 70 per cent ethanol for 1 min, 3 per cent sodium hypochlorite for 5 min in young plants and 10 min in case of older plants followed by 70 per cent ethanol wash for 1 min. They were then rinsed four times with sterile water and dried in laminar air flow. Surface disinfestations parameters like selection of disinfectant, its strength, duration of immersion in disinfectant were optimized prior to experimentation. The cut ends of surface sterilised segments were removed with flame sterilized scalpel and were placed in appropriate agar media with the cut surface touching the agar. The plates were incubated for four to eight days at 28 ˚C and liquid from plant sample oozes from cut ends due to osmotic pressure. The oozed liquid contains endophytes which forms growth on agar plate on edged of plant sample touching agar. The plates were observed for the presence of bacterial endophytes. Further, based on characterisation and screening five efficient isolates *viz.*, ESR-6 (*Pseudomonas* sp.), ESY-15 (*Bacillus* sp.), ESK-26 (*Bacillus* sp.), ESK-32 (*Bacillus* sp.) and ESB-44 (*Acinetobacter* sp.) were selected for pot experiment.

Different growth parameters (plant height, number of leaves per plant, number of branches per plant, shoot dry weight, root dry weight and total dry matter production) were set to evaluate the efficiency of endophytic bacterial isolates. The observations were recorded at different intervals like 30 Days after Sowing (DAS), 60 DAS and 90 DAS of the crop.

Pot culture experiment

The pot culture experiment was conducted in the glass house of Department of Agricultural Microbiology, University of Agricultural Sciences, Raichur during 2019 to study the effect of endophytic isolates on growth parameters of chilli

Details of pot experiment

The treatment was laid out in Completely Randomized Design (CRD) with three replications. The treatment details were furnished in Table 1.

Table 1: Experimental details of pot experiment

Sl. No.	Particulars	Details
1	Treatments	T_1 - Uninoculated control
		T_2 - 100% RDF
		T_3 - 75% RDF + Efficient isolate of endophytic bacteria (ESK-26)
		T_4 - 75% RDF + Efficient isolate of endophytic bacteria (ESR-6)
		T_5 - 75% RDF + Efficient isolate of endophytic bacteria (ESK-32)
		T_6 - 75% RDF + Efficient isolate of endophytic bacteria (ESY-15)
		T_7 - 75% RDF + Efficient isolate of endophytic bacteria (ESB-44)
		T_8 - 75% RDF + (ESK-26) + (ESR-6)
		T_9 - 75% RDF + (ESK-26) + (ESK-32)
		T_{10} - 75% RDF + (ESK-26) + (ESY-15)
		T_{11} - 75% RDF + (ESK-26) + (ESB-44)
		T_{12} - 75% RDF + (ESR-6) + (ESK-32)
		T_{13} - 75% RDF + (ESR-6) + (ESY-15)
		T_{14} - 75% RDF + (ESR-6) + (ESB-44)
		T_{15} - 75% RDF + (ESK-32) + (ESY-15)
		T_{16} - 75% RDF + (ESK-32) + (ESB-44)
		T_{17} - 75% RDF + (ESY-15) + (ESB-44)
		T_{18} - 75% RDF + Reference strain
2	Crop	Chilli
3	Design	Completely Randomized Design (CRD)
4	Replication	3
5	Treatment	18

Preparation of pots

The potting mixture in all the experiments consisted of soil: farmyard manure in 2:1 proportion was sieved through a 4 mm mesh and then autoclaved for 3 h at 121˚C in autoclavable plastic bags. The soil having physiochemical properties of pH 7.2, Electrical conductivity 0.26 dS/m, organic carbon 0.93 per cent, available nitrogen 290.6 kg/ha, available phosphorus 11.24 kg/ha and available potassium 106.00 kg/ha were also analyzed before filling the pots. Each earthen pot was filled with the 10 kg of sterilized soil.

Bacterial culture preparation for seed inoculation

The endophytic isolates *viz.*, ESK-26, ESR-6, ESK-32, ESY-15 and ESB-44 and consortium of the above five was used for

this study. A loopful of the endophytic isolates were inoculated into the nutrient broth and incubated in a rotary shaker at 150 rpm for 48 h at room temperature (28 ˚C). After 48 h of incubation, ten milliliter of the broth containing a population of 10^8 cfu/ml was used for inoculation. The bacterial strains were grown separately and the five strains that are going to make up the combination were added equally (v/v) and finally mixed at the time of inoculation.

Seed bacterization

Chilli seeds were surface sterilized with 70 per cent ethanol for 1 minutes, 3 per cent sodium hypochlorite for 5 minutes followed by 70 per cent ethanol wash for 1 min, rinsed in sterile distilled water thrice and dried overnight under sterile air stream.

Required quantity of seeds were soaked in ten ml of bacterial suspension containing 10^8 cfu/ml for 12 h and dried under laminar air flow. The seeds soaked in sterile distilled water were maintained as control. Seeds were sown in respectively labelled pots at a depth of 5-6 cm followed by water application was carried out to moisten the seeds to encourage germination.

Phyllosphere Spray (PS)

The phyllosphere spray was given at the flowering stage of the crop. The standard inoculum of the test endophytic isolate combination was diluted at 1:1 ratio with sterile water and sprayed on the leaf at early morning or evening to have uniform wetting.

Observations recorded for chilli

Observations on plant growth parameters were recorded at 30, 60 and 90 DAS of the chilli crop.Height of the plant from base to the tip of the main stem was recorded in centimetres and the mean value was calculated. The total number of leaves in the plant was counted and the mean was calculated and expressed as number. Total number of branches on each plant was counted and the average number of branches were calculated.

The root length was measured from the base of the plant to the base of the root tip which was expressed in centimetres. Root lengths were recorded at an interval of 60 and 90 DAS. The shoots and roots were first washed and then dried in shade for 24 to 36 h. Then they were dried in hot air oven at 50 ˚C until constant dry weight was obtained and the average dry weight of the plant was expressed in grams.

Result and discussion

Isolation of endophytic bacteria

The bacterial endophytes were isolated from root, stem and leaves of chilli plants which are collected from north eastern zones of Karnataka. Out of 50 plant samples, 48 isolates were obtained and purified by streak plate technique.

Growth parameter

The inoculation effect of endophytic bacteria with 75% RDF on growth parameters of chilli plants were studied under pot culture conditions using five efficient strains of endophytic bacteria (ESK-26, ESR-6, ESK-32, ESY-15 and ESB-44) selected on the basis of biochemical characterisation, molecular characterisation and production of growth promoting substances.

The data pertaining to plant height, number of leaves per plant, number of branches per plant, root length, shoot dry weight, root dry weight and total dry weight of chilli plant at various stages of crop growth was influenced by bacterial inoculation of endophytes were presented in Table 2, 3, 4, 5, 6, 7 and 8.

The result indicated that the treatment T_8 inoculated with endophytic bacterial consortia recorded highest plant height (19.62 cm, 32.52 cm and 53.54 cm) and number of leaves per plant (13.26, 36.24 and 68.72) at 30, 60 and 90 DAS respectively, which was significantly superior over all other treatments. The present results were in line with Khan *et al*. (2020) [7] reported that, inoculation of endophytic bacterial strain *P. polymyxa* SK1 had a positive correlation in terms of increased plant height.

It was due to the isolated strain SK1 showed plant growth-promoting traits such as the production of organic acids, ACC deaminase, IAA, siderophores, nitrogen fixation, and phosphate solubilization.

Similar outcomes were noticed with Rohini *et al*. (2018) [8] observed that, inoculation of endophytic bacterial strain ZoB19 (*Enterobacter cloacae*) had profuse effect on leaf number in *Vigna unguiculata*. It was due to balanced regulation on various PGP traits such as phosphate solubilization, 1-amino cyclopropane 1-carboxylate (ACC) deaminase activity, nitrogen fixation, and ammonia and IAA production. The result obtained in the present study indicated that, significantly highest number of branches per plant (4.38 and 6.24), root length (8.94 cm and 13.35 cm), shoot dry weight (10.13 g/plant and 18.65 g/plant), root dry weight (1.70 g/plant and 2.33 g/plant) and total dry weight (11.83 g/plant and 20.98 g/plant) of chilli plant was recorded at 30 and 60 DAS respectively. A similar observations were also made by Suleman *et al*. (2018) [14] reported that wheat inoculation with selected endophytic strain MS16 showed pronounced effect on number of tillers in field trials. It was due to phosphate solubilization activity, indole-3-acetic acid, gibberellic acid, solubilized zinc compounds and showed nitrogenase and 1- Aminocyclopropane-1-carboxylic acid deaminase activity. The results were in agreement with Singh and Arora (2016) [12] who reported that inoculation with endophytic bacteria *Pseudomonas strain* PSE-1 significantly improved root length under field condition. It was due to multiple PGP characters such as phosphate solubilization activity, indole acetic acid (IAA), ammonia and siderophore production. Similar observation were noticed by Safdarpour and Khodakaramian (2019) [9] who reported that, the increased tomato biomass was noticed by the inoculation of endophytic bacterial strains *P. mosselii, P. fluorescens, S. maltophilia* and *A. Calcoaceticus*. It was due to plant growth promoting bacteria (PGPB) that include the production of phytohormones such as indole-3-acetic acid (IAA), nitrogen fixation, phosphate solubilization and iron sequestration by bacterial siderophores.

Table 2: Influence of endophytic bacterial isolates on plant height at different growth stages of chilli under pot experiment

Treatment	Plant height of chilli (cm)		
	30 DAS	60 DAS	90 DAS
T_1 - Uninoculated control	10.43^{l}	15.15^{j}	24.18^{i}
T_2 - 100% RDF	12.00^{k}	19.76^{i}	38.14^{h}
T_3 - 75% RDF + (ESK-26)	13.67^{gh}	24.64^{fg}	43.24^{ef}
T_4 - 75% RDF + (ESR-6)	12.61^{ijk}	22.74^{h}	42.50^{f}
T_5 - 75% RDF + (ESK-32)	12.42^{jk}	20.98^{i}	40.70^{g}
T_6 - 75% RDF + (ESY-15)	12.18^{jk}	20.06^{i}	39.86^{g}
T_7 - 75% RDF + (ESB-44)	$12.16j^{k}$	19.86^{i}	39.56^{gh}
T_8 - 75% RDF + (ESK-26) + (ESR-6)	19.62^{a}	32.52^{a}	53.54^{a}
T_9 - 75% RDF + (ESK-26) + (ESK-32)	17.80^{b}	30.04^{b}	50.75^{b}
T_{10} - 75% RDF + (ESK-26) + (ESY-15)	16.33^{cd}	27.56^{cd}	46.28^{d}
T_{11} - 75% RDF + (ESK-26) + (ESB-44)	15.45^{de}	26.92^{cde}	45.07^{d}
T_{12} - 75% RDF + (ESR-6) + (ESK-32)	16.87^{c}	28.00^{c}	48.02^{c}
T_{13} - 75% RDF + (ESR-6) + (ESY-15)	15.88^{d}	27.17^{cde}	45.73^{d}
T_{14} - 75% RDF + (ESR-6) + (ESB-44)	14.84^{ef}	26.08^{def}	44.84^{de}
T_{15} - 75% RDF + (ESK-32) + (ESY-15)	14.06^{fg}	25.83^{ef}	44.77^{de}
T_{16} - 75% RDF + (ESK-32) + (ESB-44)	13.87^{gh}	25.13^{f}	43.33^{ef}
T_{17} - 75% RDF + (ESY-15) + (ESB-44)	13.06^{hij}	23.17^{gh}	42.63^{f}
T_{18} - 75% RDF + Reference strain	13.33^{ghi}	23.33^{gh}	42.82^{f}
S.Em ±	0.31	0.52	0.57
CD at 5%	0.91	1.56	1.71

DAS: Days after Sowing

*Mean values followed by the different letter are significantly different ($P< 0.05$) from each other as evaluated from Duncan's multiple range test (DMRT).

Table 3: Influence of endophytic bacterial isolates on number of leaves at different growth stages of chilli under pot experiment

Treatment	Number of leaves per plant		
	30 DAS	60 DAS	90 DAS
T_1 - Uninoculated control	5.48^{l}	18.92^{j}	42.70^{m}
T_2 - 100% RDF	9.80^{k}	25.54^{i}	53.56^{l}
T_3 - 75% RDF + (ESK-26)	11.62^{efg}	28.76^{fgh}	59.70^{fgh}
T_4 - 75% RDF + (ESR-6)	10.72^{hij}	27.6^{h}	57.06^{ij}
T_5 - 75% RDF + (ESK-32)	10.48^{ijk}	26.42^{i}	55.44^{jk}
T_6 - 75% RDF + (ESY-15)	10.06^{jk}	25.87^{i}	54.18^{kl}
T_7 - 75% RDF + (ESB-44)	9.86^{k}	25.62^{i}	53.83^{kl}
T_8 - 75% RDF + (ESK-26) + (ESR-6)	13.26^{a}	36.24^{a}	68.72^{a}
T_9 - 75% RDF + (ESK-26) + (ESK-32)	13.02^{ab}	34.48^{b}	66.14^{b}
T_{10} - 75% RDF + (ESK-26) + (ESY-15)	12.72^{abc}	32.6^{c}	64.72^{bc}
T_{11} - 75% RDF + (ESK-26) + (ESB-44)	12.43^{bcd}	30.13^{de}	62.76^{de}
T_{12} - 75% RDF + (ESR-6) + (ESK-32)	12.94^{ab}	33.78^{b}	65.68^{b}
T_{13} - 75% RDF + (ESR-6) + (ESY-15)	12.72^{abc}	30.96^{d}	63.13^{cd}
T_{14} - 75% RDF + (ESR-6) + (ESB-44)	12.22^{cde}	29.74^{ef}	61.25^{ef}
T_{15} - 75% RDF + (ESK-32) + (ESY-15)	12.04^{cdef}	29.62^{ef}	60.60^{fg}
T_{16} - 75% RDF + (ESK-32) + (ESB-44)	11.8^{def}	28.92^{fg}	60.05^{fgh}
T_{17} - 75% RDF + (ESY-15) + (ESB-44)	10.96^{ghi}	27.95^{h}	58.38^{hi}
T_{18} - 75% RDF + Reference strain	11.33^{fgh}	28.03^{gh}	59.17^{gh}
S.Em ±	0.24	0.39	0.56
CD at 5%	0.72	1.17	1.67

DAS: Days after Sowing

*Mean values followed by the different letter are significantly different ($P< 0.05$) from each other as evaluated from Duncan's multiple range test (DMRT).

Table 4: Influence of endophytic bacterial isolates on number of branches at different growth stages of chilli under pot experiment

Treatment	Number of branches per plant	
	60 DAS	90 DAS
T_1 - Uninoculated control	2.38^{m}	3.36^{i}
T_2 - 100% RDF	2.80^{l}	3.78^{h}
T_3 - 75% RDF + (ESK-26)	3.12^{ghi}	4.4^{ef}
T_4 - 75% RDF + (ESR-6)	2.92^{jkl}	4.30^{f}
T_5 - 75% RDF + (ESK-32)	2.90^{kl}	4.06^{g}
T_6 - 75% RDF + (ESY-15)	2.86^{l}	3.82^{h}
T_7 - 75% RDF + (ESB-44)	2.82^{l}	3.78^{h}
T_8 - 75% RDF + (ESK-26) + (ESR-6)	4.38^{a}	6.24^{a}
T_9 - 75% RDF + (ESK-26) + (ESK-32)	4.12^{b}	5.92^{b}
T_{10} - 75% RDF + (ESK-26) + (ESY-15)	3.71^{d}	5.80^{c}
T_{11} - 75% RDF + (ESK-26) + (ESB-44)	3.40^{e}	4.68^{cd}

T_{12} - 75% RDF + (ESR-6) + (ESK-32)	3.94^{c}	5.87^{b}
T_{13} - 75% RDF + (ESR-6) + (ESY-15)	3.56^{d}	4.71^{c}
T_{14} - 75% RDF + (ESR-6) + (ESB-44)	3.28^{ef}	4.56^{de}
T_{15} - 75% RDF + (ESK-32) + (ESY-15)	3.26e^{fg}	4.56^{de}
T_{16} - 75% RDF + (ESK-32) + (ESB-44)	3.20^{fgh}	4.42d^{ef}
T_{17} - 75% RDF + (ESY-15) + (ESB-44)	3.02^{ijk}	4.36^{ef}
T_{18} - 75% RDF + Reference strain	3.06^{hij}	4.40^{ef}
S.Em ±	0.06	0.07
CD at 5%	0.16	0.21

DAS: Days after Sowing

*Mean values followed by the different letter are significantly different (P< 0.05) from each other as evaluated from Duncan's multiple range test (DMRT).

Table 5: Influence of endophytic bacterial isolates on root length at different growth stages of chilli under pot experiment

Treatment	Root length (cm)	
	60 DAS	90 DAS
T_1 - Uninoculated control	4.16^{l}	5.80^{j}
T_2 - 100% RDF	5.18^{hij}	7.00^{i}
T_3 - 75% RDF + (ESK-26)	5.38^{gh}	7.82^{gh}
T_4 - 75% RDF + (ESR-6)	4.89^{ijk}	7.46^{hi}
T_5 - 75% RDF + (ESK-32)	4.80^{jk}	7.31^{hi}
T_6 - 75% RDF + (ESY-15)	4.75^{k}	7.30^{hi}
T_7 - 75% RDF + (ESB-44)	4.70^{k}	7.08^{i}
T_8 - 75% RDF + (ESK-26) + (ESR-6)	8.94^{a}	13.35^{a}
T_9 - 75% RDF + (ESK-26) + (ESK-32)	8.22^{b}	12.55^{b}
T_{10} - 75% RDF + (ESK-26) + (ESY-15)	7.28^{d}	11.02^{d}
T_{11} - 75% RDF + (ESK-26) + (ESB-44)	6.15^{f}	10.20^{e}
T_{12} - 75% RDF + (ESR-6) + (ESK-32)	7.80^{c}	11.70^{c}
T_{13} - 75% RDF + (ESR-6) + (ESY-15)	6.82^{e}	10.94^{d}
T_{14} - 75% RDF + (ESR-6) + (ESB-44)	5.70^{g}	9.31^{f}
T_{15} - 75% RDF + (ESK-32) + (ESY-15)	5.65^{g}	9.30^{f}
T_{16} - 75% RDF + (ESK-32) + (ESB-44)	5.38^{gh}	8.26^{g}
T_{17} - 75% RDF + (ESY-15) + (ESB-44)	5.14^{hij}	7.50^{hi}
T_{18} - 75% RDF + Reference strain	5.20^{hi}	7.76^{gh}
S.Em ±	0.13	0.19
CD at 5%	0.39	0.57

DAS: Days after Sowing

*Mean values followed by the different letter are significantly different (P< 0.05) from each other as evaluated from Duncan's multiple range test (DMRT).

Table 6: Influence of endophytic bacterial isolates on shoot dry weight at different growth stages of chilli under pot experiment

Treatment	Shoot dry weight (g/plant)	
	60 DAS	90 DAS
T_1 - Uninoculated control	4.12^{m}	6.35^{m}
T_2 - 100% RDF	5.10^{l}	8.60^{l}
T_3 - 75% RDF + (ESK-26)	6.02^{h}	12.00^{h}
T_4 - 75% RDF + (ESR-6)	5.50^{jk}	9.89^{j}
T_5 - 75% RDF + (ESK-32)	5.37^{jkl}	9.61^{jk}
T_6 - 75% RDF + (ESY-15)	5.30^{kl}	9.14^{kl}
T_7 - 75% RDF + (ESB-44)	5.16^{kl}	8.77^{l}
T_8 - 75% RDF + (ESK-26) + (ESR-6)	10.13^{a}	18.65^{a}
T_9 - 75% RDF + (ESK-26) + (ESK-32)	9.45^{b}	17.02^{b}
T_{10} - 75% RDF + (ESK-26) + (ESY-15)	8.12^{d}	15.6^{cd}
T_{11} - 75% RDF + (ESK-26) + (ESB-44)	7.60^{e}	14.92^{e}
T_{12} - 75% RDF + (ESR-6) + (ESK-32)	8.84^{c}	16.00^{c}
T_{13} - 75% RDF + (ESR-6) + (ESY-15)	7.70^{e}	15.10^{de}
T_{14} - 75% RDF + (ESR-6) + (ESB-44)	7.07^{f}	14.13^{f}
T_{15} - 75% RDF + (ESK-32) + (ESY-15)	6.72^{g}	13.76^{f}
T_{16} - 75% RDF + (ESK-32) + (ESB-44)	6.38^{g}	12.96^{g}
T_{17} - 75% RDF + (ESY-15) + (ESB-44)	5.66^{ij}	10.08^{j}
T_{18} - 75% RDF + Reference strain	5.92^{hi}	10.83^{i}
S.Em ±	0.12	0.23
CD at 5%	0.35	0.68

DAS: Days after Sowing

*Mean values followed by the different letter are significantly different (P< 0.05) from each other as evaluated from Duncan's multiple range test (DMRT).

Table 7: Influence of endophytic bacterial isolates on root dry weight at different growth stages of chilli under pot experiment

Treatment	Root dry weight (g/plant)	
	60 DAS	90 DAS
T_1 - Uninoculated control	0.22^{l}	0.65^{k}
T_2 - 100% RDF	0.35^{k}	0.93^{j}
T_3 - 75% RDF + (ESK-26)	0.68^{i}	1.08^{h}
T_4 - 75% RDF + (ESR-6)	0.56^{j}	1.00^{hij}
T_5 - 75% RDF + (ESK-32)	0.42^{k}	0.96^{ij}
T_6 - 75% RDF + (ESY-15)	0.39^{k}	0.95^{ij}
T_7 - 75% RDF + (ESB-44)	0.36^{k}	0.93^{j}
T_8 - 75% RDF + (ESK-26) + (ESR-6)	1.70^{a}	2.33^{a}
T_9 - 75% RDF + (ESK-26) + (ESK-32)	1.42^{b}	2.10^{b}
T_{10} - 75% RDF + (ESK-26) + (ESY-15)	0.98^{d}	1.96^{c}
T_{11} - 75% RDF + (ESK-26) + (ESB-44)	0.84^{ef}	1.58^{e}
T_{12} - 75% RDF + (ESR-6) + (ESK-32)	1.18^{c}	2.00^{c}
T_{13} - 75% RDF + (ESR-6) + (ESY-15)	0.90^{e}	1.82^{d}
T_{14} - 75% RDF + (ESR-6) + (ESB-44)	0.78^{fg}	1.45^{f}
T_{15} - 75% RDF + (ESK-32) + (ESY-15)	0.76^{gh}	1.33^{g}
T_{16} - 75% RDF + (ESK-32) + (ESB-44)	0.70^{hi}	1.33^{g}
T_{17} - 75% RDF + (ESY-15) + (ESB-44)	0.56^{j}	1.02^{hi}
T_{18} - 75% RDF + Reference strain	0.60^{j}	1.08^{h}
S.Em ±	0.04	0.04
CD at 5%	0.12	0.12

DAS: Days after Sowing

*Mean values followed by the different letter are significantly different (P< 0.05) from each other as evaluated from Duncan's multiple range test (DMRT).

Table 8: Influence of endophytic bacterial isolates on total dry weight at different growth stages of chilli under pot experiment

Treatment	Total dry weight (g/plant)	
	60 DAS	90 DAS
T_1 - Uninoculated control	4.34^{n}	7.00^{m}
T_2 - 100% RDF	5.45^{m}	9.53^{l}
T_3 - 75% RDF + (ESK-26)	6.70^{hi}	13.08^{h}
T_4 - 75% RDF + (ESR-6)	6.06^{kl}	10.89^{jk}
T_5 - 75% RDF + (ESK-32)	5.79^{klm}	10.57^{jk}
T_6 - 75% RDF + (ESY-15)	5.69^{lm}	10.09^{kl}
T_7 - 75% RDF + (ESB-44)	5.52^{m}	9.70^{l}
T_8 - 75% RDF + (ESK-26) + (ESR-6)	11.83^{a}	20.98^{a}
T_9 - 75% RDF + (ESK-26) + (ESK-32)	10.87^{b}	19.12^{b}
T_{10} - 75% RDF + (ESK-26) + (ESY-15)	9.10^{d}	17.56^{cd}
T_{11} - 75% RDF + (ESK-26) + (ESB-44)	8.44^{e}	16.50^{e}
T_{12} - 75% RDF + (ESR-6) + (ESK-32)	10.02^{c}	18.00^{c}
T_{13} - 75% RDF + (ESR-6) + (ESY-15)	8.60^{e}	16.92^{de}
T_{14} - 75% RDF + (ESR-6) + (ESB-44)	7.85^{f}	15.58^{f}
T_{15} - 75% RDF + (ESK-32) + (ESY-15)	7.48^{fg}	15.09^{fg}
T_{16} - 75% RDF + (ESK-32) + (ESB-44)	7.08^{gh}	14.29^{g}
T_{17} - 75% RDF + (ESY-15) + (ESB-44)	6.22^{jk}	11.10^{ij}
T_{18} - 75% RDF + Reference strain	6.52^{ij}	11.91^{i}
S.Em ±	0.16	0.29
CD at 5%	0.46	0.86

DAS: Days after Sowing

*Mean values followed by the different letter are significantly different (P< 0.05) from each other as evaluated from Duncan's multiple range test (DMRT).

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