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Decrease of salinity stress in groundnut by supplication of endophytic micro organism

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Abstract
An experiment was conducted during one consucutive *kharif* season from the year 2022 on "Decrease of Salinity stress in groundnut by supplication of endophytic micro organism" at Regional Research Station, Sardarkrushinagar Dantiwada Agricultural University, Kothara, Kachchh, Gujarat. The soil of experiment was loamy sand. Experiment was carried out in completely randomized block design and with six treatments for three replications. From three years experiment result revealed that in *kharif* season, application of micro-organism Endophyte 2 sequring higher pod yield, halum yield and kernal yield of groundnut. These results provide baseline information to promote an eco-friendly and sustainable agriculture.

Keywords: Ground nut, salinity stress, endophytic, micro organism

1. Introduction

Groundnut oil is expressed from the seed of *Arachis hypogaea* L., commonly known as groundnut, peanut, or earth nut, because the seed develops underground. The plant is a legume native to South America and was cultivated as early as 2000–3000 bc. Today, groundnuts are produced on a significant basis in more than 30 different countries (Dixit, 2005) [5]. The three largest producers of groundnut are India, China, and the USA. Groundnut, also known as peanut, is an immensely significant food and oil crop, cherished for the exceptional nutritional value it offers. The kernels of groundnut are a nutritional powerhouse, boasting a remarkable composition of protein (approximately 25%), oil (about 50%), antioxidants, essential minerals, and vitamins. These nutrient-dense kernels make groundnut a vital component of diets worldwide, supporting human health and well-being.

Cultivated extensively in tropical, subtropical, and warm temperate regions, groundnut has firmly established its place in global agriculture. Covering an extensive area of approximately 32.7 million hectares, groundnut production witnessed an impressive annual yield of 53.9 million tons in 2021 (according to FAOSTAT). Notably, the leading producers of groundnut are China, followed closely by India, highlighting the crop's immense economic and nutritional significance in these regions.

Groundnut's versatility and adaptability are among its most valuable attributes, making it an accessible and reliable crop for farmers across diverse agro-climatic zones. This adaptability enables groundnut to thrive in varying environmental conditions, thereby contributing to its wide-scale cultivation and subsequent global trade.

Beyond its role as a staple food, groundnut holds paramount importance in the oil industry. The high oil content in groundnut kernels, combined with its favorable fatty acid profile, makes it a favored source of edible oil worldwide. Groundnut oil is not only renowned for its delectable flavor but is also known for its heart-healthy monounsaturated and polyunsaturated fats, making it a desirable choice for health-conscious consumers.

Additionally, groundnut's rich antioxidant content, including resveratrol and other bioactive compounds, offers various health benefits. These antioxidants help combat oxidative stress and inflammation, potentially reducing the risk of chronic diseases, including heart disease and certain types of cancer.

In addition to its direct contributions to human nutrition, groundnut plays a crucial role in sustainable agriculture.

Through nitrogen fixation, groundnut improves soil fertility, making it an ideal rotational crop for enhancing the productivity of subsequent crops. Furthermore, groundnut cultivation promotes biodiversity by fostering a balanced ecosystem that benefits both the soil and surrounding plant life.

Groundnut seeds are consumed directly as raw, roasted or boiled (meal) and the oil extracted from the seeds is used as culinary oil. The oil is used in making margarine, crackers/cookies, candy, salted groundnut, salad oils, nut chocolates, sandwiches and soaps. About two thirds of world production crushed groundnut for oil (Singh, 2014).

There are two types of salinity based upon salt accumulation: dry land salinity and irrigation salinity (Chakraborty *et al*., 2013 and McFarlane *et al*., 2016) [2, 3]. Dry land salinity refers to the accumulation of salts in the soil surface of non-irrigated lands. There are three general processes which are associated with dryland salinity: deep drainage, groundwater movement, and groundwater discharge. Dry land salinity may be classified into two categories: Primary, where salinity occurs naturally, and secondary, where salinity is caused by human activities, such as agriculture. Irrigation salinity occurs when rigorous irrigation with groundwater builds up salinity on the surface of soil through repeated salt accumulation, due to the leaching of irrigation water but salts (Zaman *et al*., 2018) [4].

Plants are amenable to the detrimental effects of salinity throughout their life-cycle but are most vulnerable during the germination and seedling stage. The negative effects of salt on plant growth are related to a reduction in the osmotic potential of growing media, specific ion toxicity, and nutrient imbalance (Askari-Khorasgani *et al*., 2021) [1]. The level of salt tolerance in plants is determined by osmotic adjustment and ionic homeostasis. Excess ions in the soil water lower the solute potential (ψ_s) and thereby the total water potential (ψ_w) of the soil. To maintain water uptake and turgor under such conditions, plants need to keep their internal water potential (ψ_w) below that of the soil (Taiz *et al*., 2015) [5]. Osmotic adjustment is mediated by the accumulation of osmolytes *viz*., organic acids, sugars, and amino acids in plant cells under salt stress. Increased accumulation of osmolytes helps plants lower their water potential to facilitate water uptake from saline soils (Zhao *et al*., 2021) [7]. Plants need to maintain a balance between the accumulation of sodium (Na^+) and the loss of potassium (K^+) from the cell through ion homeostasis to ensure proper cellular functions. A high potassium-to-sodium (K^+: Na^+) ratio in tissues serves as an important indicator of higher salt tolerance in plants. Key strategies to maintain a higher K^+:Na^+ involve selective ion uptake and transport mechanisms that allow plants to either exclude or compartmentalize excess Na^+, and retain K^+. Therefore, a clear understanding of the mechanisms of salt tolerance at physiological, biochemical, and molecular levels, underlying genetics, and chromosomal regions associated with salt tolerance helps in the identification and further exploitation of tolerant genotypes. The impact of salinity on plants, their stress tolerance mechanisms, and the deployment of modern genomic and breeding approaches to understanding the genetics and mitigation of salt stress are explored in this review article.

An endophyte is any microbe (Typically fungal or bacterial) that inhabits internal tissues of plants without causing disease. All or most plants possess endophytes, and in most cases endophytes are seed transmitted and begin to promote growth and plant health as soon as seeds germinate. Other endophytes may be recruited from the soil but similarly benefit plants. Endophytic microbes are important components of plants, and they function in the following ways: (i) increase nutrients acquired by plants (ii) defend plants from pathogens and insects (iii) increase stress tolerance in plants (iv) modulate plant development and (v) suppress weed growth. The particular mechanisms by which endophytic microbes fill the various functions in plants likely differ depending on the microbe and plant. In this review, we discuss the functions of endophytes, the mechanisms of activities of endophytes, and current and future applications of endophytic microbes in crops.

The aim of present study was to determine the influence of organic sources of nutrients in different combination on growth and yield of green gram-wheat cropping sequence grown in organic farming systems.

2. Material and Methods

An experiment was conducted during *kharif* season of the year 2022 on “Decrease of Salinity stress in groundnut by supplication of endophytic micro organism” at Regional Research Station, Sardarkrushinagar Dantiwada Agricultural University, Kothara, Kachchh, Gujarat. The soil of experiment was loamy sand. Experiment was carried out in completely randomized block design and with three replication for six treatments. For *kharif* groundnut treatments were comprised as T_1: Control (C), T_2:- T_1 + Endophyte 1, T_3: T_1 + Endophyte 2, T_4 : T_1 + Endophyte 3, T_5:- T_1 + Endophyte 4 and T_6:- T_1 + Endophyte 5. Groundnut variety Locally popular Spanish variety as test crop. In *kharif* season groundnut seeds (100 kg/ha) were sown at a row distance of 30 cm. Recomended dose of fertilizers 25-50-00 kg/ha applied in all treatments. All cultural operations carried out as per recommended practices.

3. Results and Discussion

- **Plant Population:** The data pertaining to plant population per metre row length at harvest were recorded at harvest in Table 1. An examination of data indicated that different treatments tried in the experiment did not significant effect on plant count at harvest.
- **Number of root nodules:** The data indicating to number of root nodules at 45 DAS in groundnut plant as affected by different treatments are presented in Table 1.
- Higher number of root nodules per plant (24.0) recorded with the application of Endophyte 1 (T_2) microorganism and it was remain at par with treatment T_5 (Endophyte 5) and T_4 (Endophyte 4). This might be due to Endophyte microorganism promotes root development, root proliferation, nodulation and nitrogen fixation.
- **Number of pods per plant:** Data regarding number of pods per plant of groundnut crop as influenced by different Endophyte micro organism are presented in Table 1. It is evident from table 1 that application of Endophyte 5 (T_2) recorded significatly highest pods per plant (24.2). This might be due to micro organism promote growth performance crop resulted in greater accumulation of bio mass and thus its flow towards sink also led to positive improvements in number of pods per plant.
- **Pod yield:** A persual data revealed that pod yield significantly influenced by different treatments. Significantly higher pod yield *i.e.* 962.95 kg/ha was obtained under treatment T_2. The lower pod yield *i.e.* 493.33 kg/ha was observed under treatment T_1. This clearly indicates that micro organism play significant role

in producing higher pod yield. The application of Endophyte 1 upgraded the soil condition, stimulate root system with healthier absorption of nutrients, water from lower layers and expressed superior progress of plant growth resulting in higher photosynthetic activity and translocation of photosynthates to the sink which resulted in highest pod yield.

- **Kernal and Halum yield:** The data related halum and kernal yield of groundnut as influenced by different treatments are presented in Table 2. Results reveled that the differences in halum and kernal yield were found significant due to different treatments. Significantly higher halum yield (4000 gm/pot) and kernal yield (1440 kg/ha) were obtained under treatment T_2 (T_1 + Endophyte 1). It was mainly remarkable improvement in number of pods per plant ultimately resulted from proper nutrient to plant resulted in higher halum yield. The microbial formulation which is able synthesize atmospheric nitrogen, solubilize phosphate and mobilze potash into available form thereby supplementing balance nutrition to the crop and also responsible for higher yields.

Table 1: Effect of different Endotype on plant population, No. of nodules per plant and no. of pods/plant (2022)

Sr.	Treatments	Plant population at harvest				No. of Nodules per plant				No. of pods /plant			
		R-I	R-II	R-III	Mean	R-I	R-II	R-III	Mean	R-I	R-II	R-III	Mean
1	Control (C)	500	539	660	566	11.2	12.2	13.7	12.4	15.7	17.8	20.6	18.0
2	C + Endophyte 1	500	519	522	514	27.2	25.7	19	24.0	23.5	26.0	23.0	24.2
3	C + Endophyte 2	513	510	532	518	19.2	18.9	17.2	18.4	13.4	15.6	14.0	14.3
4	C + Endophyte 3	580	532	540	551	18.2	13.2	16.2	15.9	15.4	16.6	16.4	16.1
5	C + Endophyte 4	470	555	620	548	22.2	21.2	19.9	21.1	19.6	19.0	14.0	17.5
6	C + Endophyte 5	510	578	580	556	21.4	23	19.2	21.2	20.2	22.4	18.4	20.3
		S.Em. ±			9.8	S.Em. ±			1.2	S.Em. ±			0.72
		CD (P= 0.05)			NS	CD (P= 0.05)			3.7	CD (P= 0.05)			2.14
		CV (%)			8.40	CV (%)			10.88	CV (%)			12.35

Table 2: Effect of different Endotype on pod yield, karnel yield and haulm yield (2022)

Sr.	Treatments	Pod yield in gm/net plot					Karnel yield in kg/ha				Haulm yield in gm/net plot			
		R-I	R-II	R-III	Mean	Kg/ha	R-I	R-II	R-III	Mean	R-I	R-II	R-III	Mean
1	Control (C)	1100	1180	1050	1110	493.33	750	840	720	770	1850	2030	1800	1850
2	C + Endophyte 1	2350	2050	2100	2167	962.95	1530	1390	1400	1440	4000	3500	3600	4000
3	C + Endophyte 2	1450	1400	1550	1817	807.40	970	960	1050	1217	2450	2400	2550	2450
4	C + Endophyte 3	1400	1300	1330	1405	624.44	1120	950	980	1005	2400	2200	2250	2400
5	C + Endophyte 4	1500	1600	1600	1455	646.66	1110	1150	1150	1077	2500	2750	2700	2500
6	C + Endophyte 5	1100	1250	1200	1375	611.11	720	800	780	952	1800	2100	2050	1800
		S.Em. ±				14.6	S.Em. ±			17.98	S.Em. ±			10.21
		CD (P= 0.05)				43.7	CD (P= 0.05)			52.41	CD (P= 0.05)			31.74
		CV (%)				16.51	CV (%)			17.85	CV (%)			14.98

4. Conclusion

Based on findings of one year experimentation, it is concluded that application of Endophyte 1 to groundnut for decrease of salinity stress for obtaining higher groundnut equivalent yield and net return.

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