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Studies about the soil microbial populations, root development and economics of paddy as influenced by sea weed extract (*Ascophyllumnodosum*)

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Abstract
A field trial was conducted at the Student's Instructional Farm (SIF) of Chandra Sekhar Azad University of Agriculture and Technology, Kanpur during *Kharif* Season of 2018 to find out the used time of sea weed extract (*Ascoplyllumnodosum*) to soil health improvement, root development and economics on paddy. The experiment comprises of ten treatments combinations viz. Control (RDF), RDF + SoliGro Gr @ 10 kg/ha at FLP, RDF+SoliGro @ 10 kg/ha at 25 DAT, RDF+SoliGro @ 10 kg/ha at 45 DAT, RDF+SoliGro @ 10 kg/ha at 65 DAT, RDF+SoliGro @ 10 kg/ha at FLP & 25 DAT, RDF+SoliGro@ 10 kg/ha at FLP & 45 DAT, RDF +SoliGro @ 10 kg/ha at FLP &65 DAT, RDF+SoliGro @ 10 kg/ha at FLP, 25 & 45 DAT, RDF+SoliGro@ 10 kg/ha at FLP, 25, 45 & 65 DAT. The field was laid out in Randomized Block Design with three replications. The paddy variety NDR-359 was transplanted at spacing of 20cm×10cm a part. Results observed that significantly higher root hairs/hill, was found with the application of RDF+ two times application of SoliGro Gr @ 10 kg/ha at final land preparation time and 25 days after transplanting of rice. The treatment of recommended dose of fertilizer along with two times applied SoliGro Gr @ 10 kg/ha at final land preparation time and 25 days after transplanting of rice crop statistically increased the grain yield, net income and return per rupee, compared to all remaining treatments, respectively.

Keywords: Sea weed extract soil microbial population, root development

Introduction
Demand of foods are increasing with of increasing population as a result the demand for chemical fertilizer is also increasing for producing more yields in limited area of cultivation. The excessive use of chemical fertilizer cause serious health hazards, limited increasing of yield and as well as pollute the environment. Recent trends of organic farming have exploited the possible application of sea weed as organic/bio-fertilizer in agriculture. Sea weeds are the important marine resource available at negligible cost and rich in diverse bioactive compounds like lipids, protein, carbohydrates, amino acids, phytoharmones, osmoprotectants, mineral nutrients and antimicrobial compounds. The use of natural seaweeds as fertilizer has allowed the gradual substitution of conventional synthetic fertilizers Sasikala *et al.* (2016) [6].
In India more than 500 species of sea weed are found to be commercially important. The main sea weed producing states are Tamil Nadu, Maharashtra, Goa, Gujarat, Andhra Pradesh and Karnataka. However, some species are used in agricultural purpose. Different formulations of sea weed such as LSF (Liquid Seaweed Fertilizer), granular and powder are available in market. The whole or finally chopped powered algal manure have been used and all of them have been reported to produce beneficial effects on cereals, pulses, and many flowering plant. The advantage of seaweed manure is that it is free from weed seeds and other pathogenic fungi.
SoliGro GR is a soil health product powered by Acadian Bio Switch bioactive compound which enhance natural process within soil resulting in root development, microbial activity. Soil conditioning, plant growth and help protect crops against environmental stresses. It is a soil health product contains and exclusive mixture of bio active compounds such as polysaccharides, organic acid *in vigo* rate soil environment particularly by promoting the activities of beneficial soil microorganism. SoliGro GR Provides balanced nutrition for optimum growth, yield and quality; it helps plant to overcome abiotic environmental stresses like drought, salinity, cold and frost efficiency and finally, boosts the immune system of the plant.

Materials and methods

A field experiment was conducted at Student's Instructional Farm, Chandra Sekhar Azad University of Agriculture and Technology, Kanpur during *Kharif* season of 2018. It is situated in the central part of Uttar Pradesh at an elevation of 129.0 meters above mean sea level. It lies between 25^0 26' and 26^0 58' North latitude and 79^0 31' and $80^0$34' East longitude. The average annual rainfall is 800 mm, a major portion of which is received during the monsoon season. The soil of the experimental field is a typic eroded Gangetic alluvium. The result pertaining to soil analysis showed that experimental soil was sandy loam in texture and slightly alkaline in nature with low organic carbon and total-N content. Variety NDR-359 was transplanted, the maturity period of this variety is 132-135 days and the suitable areas for this variety are Uttar Pradesh and all Eastern areas. Nursery raising was done on 95 m^2 area to which 50.20 kg of will rotten FYM was applied and mixed in soil. Field was irrigated to permit the germination of weeds. Field was ploughed twice after a week to kill germinated weeds. Eight kilogram of seed was soaked in water containing water 20g of Bavistin @ 50 WP and 1g Streptocycline for 10 hours before sowing. This treated seed was kept under wet gunny bags and kept it moist by sprinkling water to germinate the treated seed. Nursery was irrigated before uprooting, 25 days old seedlings was uprooted and transplanted two seedlings per hill about 2-3 cm deep in puddled field in lines at 20×15 cm spacing manually. The transplanting of rice (NDR-359 was done on 02 August during 2018. Harvesting of test crops in all the plots were done at maturity. Subsequently, crops in net plot area were harvested separately in each net plot area. Harvesting was done with hand sickles by manual labour.

Results and discussion

Effect of granules on soil microbial population

The data revealed that the soil microbial population (cfu ml^{-1}) at PDA (10^6 dilution) were significantly higher recorded (19.54) under the recommended dose of fertilizer with two times application of SoliGro Gr @ 10 kg ha^{-1} at final land preparation time and 25 days after transplanting of crop. Sriramchandrasekaran *et al.* (2004) [8]. PDA (10^7 dilution) significantly higher (8.30) was recorded under the recommended dose of fertilizer with two times application of SoliGro Gr @ 10 kg ha^{-1} at final land preparation time and 25 days after transplanting of crop. It was at par with application of SoliGro Gr @ 10 kg ha^{-1} at 25 days after transplanting. Saini *et al*. (2005) [5], Tejada *et al.* (2011) [9] and Yuan and Yue (2012) [10]. NA (10^8 dilution) significantly higher (98.77) was recorded with the application of recommended dose of fertilizer along with two times application of SoliGro Gr @ 10 kg ha^{-1} at final land preparation time and 25 days after transplanting of crop. The similar results was received soil microbial population on NA (10^9 dilution), which was at par with the application of recommended dose of fertilizer with one time used SoliGro Gr @ 10 kg ha^{-1} at 25 days after transplanting of crop. The application of seaweed extract improved the bio-chemical states and seed quality of rice. The nutrient states in plant depends on the availability of particular element in the soil, it is incorporation in the form of fertilizers and mainly on the genetic efficiency on which the uptake, translocation and storage it dependent. The similar results were related to Bhahadur *et al.* (2012) [1].

Effect of granules on root development

The higher root hairs/hill (79.49) were found with the application of RDF+ two times application of SoliGro Gr @ 10 kg/ha at final land preparation time and 25 days after transplanting of rice. But not significantly response of root length of paddy on soligro Gr @ 10 kg/ha at different used time. The numerically similar results was observed root length of rice crop in present investigation. In case of root dry weight $hill^{-1}$ of crop it was observed that the non significantly higher (7.16 g $hill^{-1}$) with the - application of recommended dose of fertilizer and two time application of SoliGro Gr @ 10 kg ha^{-1} at final land preparation time and 25 days after transplanting of crop. The similar results conformity by Banwasi and Bajpai (2001) [2], Singh *et al.* (2005) and Korndo (2009).

Effect of granule on yield and economics

The grain yield was significantly higher (54.84 q/ha) recorded under the application of SoliGro Gr @ 10 kg/ha at final land preparation time and 25 days after transplanting of rice crop. Seaweed extracts are known to improve the source-sink relationship translocation of photo assimilates and there by photosynthetic ability of plants and thus play significant role in realization of high productivity levels and higher crop yields. Our finding similar to Rao *et al.* (2014).

The RDF with four times applied SoliGro Gr @ 10 kg/ha at final land preparation time 25-45 and 65 days after transplanting was statistically maximum gross income (Rs. 123437/ha) compared to rest treatment, respectively. The higher net incomes of Rs. 58599/ha were computed at two times applied SoliGro Gr @ 10 kg/ha at final land preparation time and 25 days after transplanting along with recommended dose of fertilizers over remaining treatment. The significantly maximum return per rupee (1.95) was noted on applied SoliGro Gr @ 10 kg/ha at 25 days after transplanting along with recommended dose after fertilizers is most profitable. The similar result was reported by Davari *et al.* (2012), Jawahar and Vaiyapuri (2013) and Patro *et al.* (2005) [7] and Ramesh *et al.* (2009).

Table 1: Effect of SoliGro Gr @ 10 kg/ha along with RDF onsoil health and root development

Treatment	Soil microbial population (cfu ml^{-1})				Root development		
	PDA (10^6 dilution)	PDA (10^7 dilution)	NA (10^8 dilution)	NA (10^9 dilution)	Root hairs/hill	Root length (cm)	Root dry weight (g)
Control/Farmer practice (RDF)	2.25	2.61	41.29	42.87	61.74	13.37	6.04
RDF + SoliGro Gr @ 10 kg ha^{-1} at FLP time	4.34	3.61	71.50	48.86	68.16	13.86	6.68
RDF + SoliGro Gr @ 10 kg ha^{-1} at 25 DAT	18.24	8.11	97.93	69.08	77.27	14.40	7.05
RDF + SoliGro Gr @ 10 kg ha^{-1} at 45 DAT	3.24	3.30	68.31	45.54	68.13	13.81	6.67
RDF + SoliGro Gr @ 10 kg ha^{-1} at 65 DAT	2.87	3.13	46.60	44.87	61.78	13.75	6.46
RDF + SoliGro Gr @ 10 kg ha^{-1} at FLP time & 25 DAT	19.54	8.30	98.77	75.91	79.49	14.85	7.16
RDF + SoliGro Gr @ 10 kg ha^{-1} at FLP time & 45 DAT	6.85	6.28	75.95	62.58	69.35	14.11	6.83
RDF + SoliGro Gr @ 10 kg ha^{-1} at FLP time & 65 DAT	6.55	4.93	73.61	53.93	68.35	13.95	6.76
RDF + SoliGro Gr @ 10 kg ha^{-1} at FLP time, 25 & 45 DAT	8.23	6.93	78.98	65.90	73.17	14.29	6.87
RDF + SoliGro Gr @ 10 kg ha^{-1} at FLP time, 25, 45 & 65	10.28	7.08	86.40	66.91	77.64	14.44	7.07

DAT							
SE (d) ±	0.259	0.535	0.620	0.518	1.215	0.912	0.890
CD at 5%	0.547	1.133	1.313	1.096	2.573	N.A	N.A

Table 2: Effect of SoliGro Gr @ 10 kg/ha along with RDF oneconomics

Treatment	Grains yield (q/ha)	Gross income (Rs. ha-^{1})	Net income (q/ha)	B:C ratio
Control/Farmer practice (RDF)	44.09	100639	41740	1.70
RDF + SoliGro Gr @ 10 kg ha^{-1} at FLP time	49.85	112975	52409	1.86
RDF + SoliGro Gr @ 10 kg ha^{-1} at 25 DAT	53.57	120934	60302	1.99
RDF + SoliGro Gr @ 10 kg ha^{-1} at 45 DAT	49.06	111305	49639	1.80
RDF + SoliGro Gr @ 10 kg ha^{-1} at 65 DAT	47.88	108619	45920	1.73
RDF + SoliGro Gr @ 10 kg ha^{-1} at FLP time & 25 DAT	54.84	122764	58599	1.91
RDF + SoliGro Gr @ 10 kg ha^{-1} at FLP time & 45 DAT	51.97	117588	53323	1.82
RDF + SoliGro Gr @ 10 kg ha^{-1} at FLP time & 65 DAT	50.59	114888	50289	1.77
RDF + SoliGro Gr @ 10 kg ha^{-1} at FLP time, 25 & 45 DAT	54.67	123249	57616	1.87
RDF + SoliGro Gr @ 10 kg ha^{-1} at FLP time, 25, 45 & 65 DAT	54.69	123437	56238	1.83
SE (d) ±	0.718	983.30	786.56	0.063
CD at 5%	1.521	2066.54	1653.07	0.134

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