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Soil physical, physico-chemical properties and nutrient availability at harvest of soybean *kharif* soybean [*Glycine max* (L.) Merill] as influenced by weed management treatments and bio-fertilizers

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Abstract
The experiment was conducted under field conditions at Agricultural College farm, Rajendranagar. Hyderabad, Telangana State during 2014-2015 and 2015-2016, to assess the effect of Bio-fertilizers and Integrated Weed Management (IWM) Practices on soil physical, physico-chemical properties and nutrient availability at harvest of soybean. The experiment was laid out in split-plot design with three replications. The main treatments were Five Integrated Weed Management (IWM) practices and the sub plot treatments were four Integrated Nutrient Management (INM) practices. The weed management treatments and bio-fertilizers had no significant influence on soil physico-chemical properties and nutrient availability in either of the two years. The interactions were also not significant.

Keywords: Integrated weed management practices, bio-fertilizers, soil physico- chemical properties

Introduction
Soybean (*Glycine max* L.) is one of the most important oilseed crops globally (Chaudhary *et al*., 2014) [1]. Soybean [*Glycine max* (L.) Merill] is a miracle golden bean of the 20th century. It occupies third place among oilseed crops of Telangana State. It is referred as wonder crop as it contains 40% good quality protein and 20% oil high in essential unsaturated fatty acids (Layek *et al*., 2014) [2]. In Telangana state, it is grown on 2.46 lakh hectares with production of 2.63 lakh tons and productivity of 1070 kg ha^{-1}. It is widely adopted in various cropping systems. Soybean is becoming popular in Southern Climatic Zone of Telangana. Inherent low levels of soil fertility status, population of crop beneficial microbes including rhizobium, phosphorus solubilising bacteria and potassium solubilising bacteria resource scarce situations are now recognized among the basic causes of low productivity. Improvements in biological nitrogen fixation can help to enhance soybean productivity per unit area. Weeds are a permanent constraint to crop productivity in agriculture. They are plants, which compete for nutrients, space, light, moisture and exert a lot of harmful effects by reducing the quality as well as quantity of the crop if the weed populations are left uncontrolled (Singh and Sheoran, 2008) [4].

Material and methods
A field study was conducted at Agricultural College Farm, Rajendranagar, Hyderabad, Telangana state during cropping season of 2014 and 2015.The soil was sandy loam in texture having 7.8 pH and EC 0.21 d S m^{-1}. It was very poor in nutrient status with 0.35% OC and 226 kg ha^{-1} available N, available P was 18 kg $ha^{-1}$and available K was 236 kg ha^{-1}. The layout was a split plot design. The main treatments were: (W1) Pre-emergence application of pendimethalin @ 1.0 kg a.i ha^{-1} followed by hand weeding 25 DAS, (W2) Pre emergence application of pendimethalin @1.0 kg a.i ha^{-1} followed by post-emergence application of imazethapyr @ 100 g a.i ha^{-1}+ quizalofop-p-ethyl @ 50 g a.i ha^{-1} 25DAS, (W3) Pre-emergence application of pendimethalin @1.0 kg a.i ha^{-1} followed by post-emergence application of odyssey i.e. imazethapyr + imazamox@ 70 g a.i ha^{-1} at 25 DAS, (W4) Hand weeding at 25 and

45 DAS and (W5) un-weeded check. The sub plot treatments comprising of (F1) Recommended dose of fertilizers @ 30:60:40 kg ha^{-1} NPK, (F2) RDF+ seed treatment with rhizobium @ 250g 10kg^{-1}seed, (F3) RDF +seed treatment with rhizobium @ 250g 10kg^{-1} seed + phosphate solubilizing bacteria @ 5 kg ha^{-1}, (F4) RDF + seed treatment with rhizobium @ 250 g10 kg^{-1} seed + phosphate solubilising bacteria @ 5 kg ha^{-1} + potassium solubilising bacteria@ 5kg ha^{-1}. Recommended fertilizer dose of 30:60:40 kg ha^{-1} NPK was calculated for the dimensions of each sub plot and applied at the time of sowing in the form of urea. Single super phosphate and muriate of potash. Seed rate was @ 63 kg ha^{-1}. The bio-fertilizers *Brady rhizobium japonica* were mixed as per the treatment in jaggery solution prepared @ 250 g for 10 kg seed. The seed was thoroughly mixed with the solution and shade dried. The Phosporos solubilising bacteria and potassium solubilising bacteria were applied @ 5 kg ha^{-1} after mixing with FYM. The seeds were dibbled at the rate of two per hill 10 cm apart in 30cm interval. The crop was sown on 10th July in 2014 and 18th June in 2015.A pre emergence herbicide (Pendimethalin 30%EC) was applied on next day of sowing and post emergence application of (imazethapyr 10% SL, Quizalofop-p-ethyl 5% EC and odyssey) was done 25 DAS with the help of knapsack sprayer fitted with flat fan nozzle. The dry matter samples of the crop and weeds collected at the time of harvest were dried, powdered and analysed for the total nitrogen, phosphorus and potassium by dry weight and uptake is expressed as $kgha^{-1}$.

% nutrient content x dry matter (kg ha^{-1})

$$\text{Nutrient uptake (kg ha}^{-1}\text{)} = \frac{\text{\% nutrient content x dry matter (kg ha}^{-1}\text{)}}{100}$$

The methods adopted for estimation of nutrients are furnished in Table 1

Table 1: Methods adopted for estimation of nutrients

Nutrient	Method
Nitrogen	Micro kjeldahl distillation.
Phosphorus	Vanado-molybdo-phosphoric yellow colour.
Potassium	Flame photometer.

The experimental data was subjected to statistical test by following analysis of variance technique suggested by Panse and Sukhatme (1978).

Results and discussions

The Soil physico, chemical properties like Bulk density, organic carbon, pH, EC and available N:P_2O_5:K_2O are presented in the table. The weed management treatments and bio-fertilizers had no significant influence on soil physico-chemical properties and nutrient availability in either of the two years. The interactions were also not significant.

Table 2: Soil Physical, Physico-chemical properties and nutrient availability at harvest as influenced by weed management treatments and bio-fertilizers during

Treatment	Physical, Physico-chemical properties				Available nutrient $kgha^{-1}$		
	Bulk density (Mg/m^3)	pH	EC ds/m	Organic carbon (%)	N	P_2O_5	K_2O
Weed management							
W1:PE Pendimethalin @ 1kg *a.i* ha^{-1}fb Hand weeding at 25DAS	1.33	8.06	0.203	0.35	229	18.5	317
W2:PE Pendimethalin @ 1kg *a.i* ha^{-1}fb PoE Imazethapyr @100 g *a.i* ha^{-1}+ Quizalofop- P-ethyl @ 50 g *a.i* ha^{-1}25DAS	1.34	8.01	0.201	0.34	227	18.2	315
W3:PE Pendimethalin @ 1kg *a.i* ha^{-1}fb PoE Imazethapyr + Imazamox@ 70 g *a.i* ha^{-1}25DAS	1.34	8.16	0.204	0.35	228	18.5	315
W4:Hand weeding at 25 and 45 DAS	1.33	8.23	0.202	0.36	236	18.8	319
W5:Unweeded check	1.34	8.20	0.203	0.33	220	18.0	310
SE±	0.06	2.3	0.004	0.08	21	0.43	1.8
CD(P=0.05)	NS	NS	NS	NS	NS	NS	NS
Bio-fertilizers							
F1:Fertilizers @ 30:60:40 kg ha^{-1} N:P_2O_5:K_2O	1.33	8.03	0.204	0.34	228	18.2	315
F2:F1 + Rhizobium @ 250g10 kg^{-1} seed	1.33	8.16	0.203	0.35	225	18.4	314
F3:F2 + Phosphate solubilising bacteria @ 5 kg ha^{-1}	1.35	8.14	0.204	0.34	226	18.1	315
F4:F3+ Potassium solubilising bacteria @ 5 kg ha^{-1}	1.32	8.21	0.208	0.36	238	18.3	316
SE±	0.03	2.0	0.004	0.07	19	0.78	1.2
CD(P=0.05)	NS	NS	NS	NS	NS	NS	NS
Weed Management x Bio-fertilizer							
SE±	0.08	4.2	0.009	1.4	59	1.76	2.7
CD(P=0.05)	NS	NS	NS	NS	NS	NS	NS
Initial values	1.32	7.8	0.21	0.35	226	17	236

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