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Weed Density, Weed Dry Weight and Quality of Soybean [*Glycine max (L.) Merill*] as Influenced by Integrated Weed Management

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ABSTRACT

The experiment was conducted under field conditions at Agricultural College farm, Rajendra nagar. Hyderabad, Telangana State during 2014–2015 and 2015–2016, to assess the effect of Bio-fertilizers and Integrated Weed management Practices on weed growth and quality of soybean. The experiment was laid out in split-plot design with three replications. The main treatments were Five IWM practices and the sub plot treatments were 4 INM practices. The pre and post emergence application of herbicides had reduced the weeds density and dry weights on par with the integrated weed management by the pre-emergence application of pendimethalin @ 1.0 kg *a.i* $ha^{-1}$and hand weeding at 25 DAS. This trend was same during 2014 and 2015.The protein content ranged from 40.1 to 41.0 per cent in seed during the first year and from 40.1 to 41.3 per cent in the second year The cultural and herbicide application methods of weed management did not influence the protein per cent significantly.

Key Words: *Integrated Weed Management Practices, Seed Quality, Weed Density and Weed Dry Weight.*

Soybean (Glycine max L.) is one of the most important oilseed crops globally (Chaudhary et al., 2014). 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). Weeds are a permanent constraint to crop productivity in agriculture. The major proportion of weeds was broad leaf types followed by sedges and grasses. Prominent among grasses were *Cynodon dactylon, Rottboellia exaltata and Dactyloctenium aegyptium.* The sedge was *Cyperus rotundus.* Among the broad leaved weed the prominent species were *Celosia argentea, Commelina benghalensis, Euphorbia hirta, Digeria arvensis, Hemidesmus indicus* and *Trianthema portulacastrum.* 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). It is a laborious, time consuming and expensive method. Use of suitable herbicide provides more effective and efficient weed control. The crop is highly sensitive to early weed infestation during the seedling stage and the critical crop-weed competition during 3-4 weeks after sowing (Jha *et al*.,2014) The indiscriminate urbanization, labour shortage and spiraling wages compel the farmers to switch over to the chemical weed control. The herbicides are apprehended to have direct or indirect consequences on non-targeted organisms including soil micro flora in the field. Hence, the present investigation was undertaken to study the bio-efficacy of herbicide combinations and bio-fertilizer management on the quality of soybean and weed density and weed dry weight.

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 soybean variety JS-335 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 18 th June in 2015and 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 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 @ 250g10kg^{-1}seed, (F3) RDF+seed treatment with rhizobium @ 250g10kg^{-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}. 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. 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 weed density and weed dry weight was recorded at 20,40 and 60 days after planting. The quality of Soybean were recorded from the experimental data was subjected to statistical test by following analysis of variance technique suggested by Panse and Sukhatme (1978).

RESULTS AND DISCUSSION

Weed density

The results showed that there was a high population of 66.30 and 68.69 weeds m^{-2} at 20 DAS during 2014 and 2015 in the un-weeded check. The pre-emergence application of pendimethalin @ 1.0 kg *a.i* ha^{-1} significantly reduced the weeds to 27.24 and 28.88 m^{-2} in the corresponding years. By 40 days a high density of 148.29 and 149.49 m^{-2} weeds were recorded in the un-weeded check. Because of hand weeding at 25 days a low density of 30.82 and 37.21 weeds m^{-2} was recorded at 40 days. This was on par with the density of 31.99 and 33.94 m^{-2} due to the integrated weed management. . A high density of 160.25 and 162.90 weeds m^{-2} existed by 60 days in the 2 years. Sangeetha *et al.* (2014) also recorded a huge density of 309 weeds in 1st year and 517 weeds m^{-2} in the 2 year at 35 days.

weed dry weight

The weed dry weight increased with crop age in the un-weeded check. The weeds weighed 7.19 g during 2014 and 7.00 g m^{-2} during 2015 in the un-weeded checks 20 DAS. By 40 DAS the weed dry matter was 99.21 and 97.47 g m^{-2} in the corresponding years. Maximum weed dry weight of 193.52 g and 206.57 g m^{-2} was recorded in the un-weeded check at 60 days during 2014 and 2015 respectively. The *Rhizobium*, phosphate and potassium solubilising formulations did not influence the dry weight and weed density Singh (2005) also observed that the weed dry weight of 134 g m^{-2} at 45 days was reduced to 12.3 g m^{-2} by weeding at 30 days

Quality of Soybean

The protein content ranged from 40.1 to 41.0 per cent in seed during the first year and from 40.1 to 41.3 per cent in the second year The cultural and herbicide application methods of weed management did not influence the protein per cent significantly. Chamate *et al*. (2002) recorded significant improvement in the protein content of soybean seed in response to the integrated weed management. The pre-emergence application of pendimethalin @ 1.0 kg *a.i* ha^{-1} or pre plant incorporation of fluchloralin @ 1.0 kg *a.i* ha^{-1} followed by 1 hoeing at 40 days or 2 hoeings at 25 and 40 DAS increased the protein per cent compared to 1 weeding at 25 days and 1 hoeing at 40 DAS.

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Table.1 Protein percent in seed as influenced by weed management treatments and bio-fertilizers during 2014 and 2015

Treatment	Protein %	
	2014	2015
Weed management		
W1:PE Pendimethalin @ 1kg *a.i* ha^{-1}fb Hand weeding at 25DAS	40.8	41.3
W2:PE Pendimethalin @ 1kg *a.i* ha^{-1}fb PoE Imazethapyr @ 100g *a.i* ha^{-1} +Quizalofop- P-ethyl @ 50g *a.i* ha^{-1}25DAS	40.1	40.9
W3:PE Pendimethalin @ 1kg *a.i* ha^{-1}fb PoE Imazethapyr + Imazamox@ 70 g *a.i* ha^{-1}25DAS	40.7	41.3
W4:Hand weeding at 25 and 45DAS	41.0	41.2
W5:Unweeded check	40.2	40.1
SE±	0.6	0.2
CD(P=0.05)	NS	NS
Bio-fertilisers		
F1: Fertilizers @ 30:60:40 kg ha^{-1} $N:P_2O_5:K_2O$	40.5	40.5
F2:F1 + Rhizobium @ 250 g10 kg^{-1} seed	40.1	41.4
F3:F2 + Phosphate solubilising bacteria @ 5 kg ha^{-1}	40.6	41.0
F4:F3+ Potassium solubilising bacteria @ 5 kg ha^{-1}	41.1	41.4
SE±	1.0	0.8
CD(P=0.05)	NS	NS
Weed Management x Bio-fertilizers		
SE±	2.3	1.9
CD(P=0.05)	NS	NS

Table.2 Weed density (no.m^{-2}) at 20,40 and 60 DAS as influenced by weed management treatments and bio-fertilizers during 2014 and 2015

Treatments	2014			2015		
	20	40	60	20	40	60
W1: PE Pendimethalin @ 1kg *a.i* ha^{-1}fb Hand weeding at 25 DAS	5.31 (27.24)	5.74 (31.99)	7.03 (48.45)	5.46 (28.88)	5.91 (33.94)	7.23 (51.28)
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} 25 DAS	5.64 (30.83)	7.07 (49.34)	7.87 (61.04)	5.83 (32.99)	7.20 (51.14)	7.98 (62.81)
W3: PE Pendimethalin @ 1kg *a.i* ha^{-1}fb PoE Imazethapyr + Imazamo@ 70 g *a.i* ha^{-1} 25 DAS	5.77 (32.34)	6.92 (47.02)	7.75 (59.11)	5.95 (34.43)	6.99 (47.88)	7.76 (59.33)
W4: Hand weeding at 25 and 45 DAS	8.10 (64.70)	5.64 (30.82)	2.38 (4.70)	8.29 (67.88)	6.18 (37.21)	2.73 (6.48)
W5: Unweeded check	8.20 (66.30)	12.21 (148.29)	12.69 (160.25)	8.34 (68.69)	12.26 (149.49)	12.80 (162.90)
SE±	0.17	0.17	0.16	0.17	0.22	0.25
CD (P=0.05)	0.40	0.40	0.40	0.40	0.52	0.60
Bio-fertilizer						
F1: Fertilizers @ 30:60:40 kg ha^{-1} N:P_2O_5:K_2O	6.63 (43.01)	7.89 (61.28)	8.12 (65.06)	6.79 (45.17)	7.96 (62.46)	8.28 (67.59)
F2: F1 + Rhizobium @ 250 g10 kg^{-1} seed	6.74 (44.56)	7.53 (61.04)	8.20 (66.29)	6.89 (46.55)	7.65 (63.44)	8.34 (68.68)
F3: F2 + Phosphate solubilising bacteria @ 5kg ha^{-1}	6.74 (44.52)	7.88 (61.19)	8.28 (67.57)	6.90 (46.61)	8.07 (64.14)	8.34 (68.34)
F4: F3+ Potassium solubilising bacteria @ 5kg ha^{-1}	6.78 (45.04)	7.96 (62.47)	8.30 (67.92)	6.99 (47.96)	8.14 (65.34)	8.40 (69.67)
SE±	0.14	0.22	0.21	0.13	0.22	0.21
CD (P=0.05)	NS	NS	NS	NS	NS	NS
Weed Management x Bio-fertilizer						
SE±	0.32	0.51	0.48	0.31	0.50	0.47
CD (P=0.05)	NS	NS	NS	NS	NS	NS

Data transformed to $\sqrt{x+1.0}$ and original values are in parentheses

Table.3 Weed dry matter (g m^{-2}) at 20,40 and 60 DAS as influenced by weed management treatments and bio-fertilizers during 2014 and 2015

Treatments	2014			2015		
	20	40	60	20	40	60
W1: PE Pendimethalin @ 1kg *a.i* ha^{-1}fb Hand weeding at 25 DAS	1.95 (2.84)	4.28 (17.37)	7.71 (58.52)	1.96 (2.86)	4.38 (18.26)	8.14 (65.34)
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} 25 DAS	2.04 (3.19)	5.36 (27.75)	8.60 (73.10)	2.06 (3.25)	5.42 (28.41)	8.93 (78.79)
W3: PE Pendimethalin @ 1kg *a.i* ha^{-1}fb PoE Imazethapyr + Imazamo@ 70 g *a.i* ha^{-1} 25 DAS	2.09 (3.37)	5.24 (26.53)	8.47 (70.75)	2.10 (3.41)	5.22 (26.28)	8.67 (74.32)
W4: Hand weeding at 25 and 45 DAS	2.81 (6.93)	4.47 (19.08)	2.54 (5.47)	2.81 (6.92)	4.59 (20.13)	3.03 (8.24)
W5: Unweeded check	2.86 (7.19)	10.01 (99.21)	13.90 (193.52)	2.82 (7.00)	9.92 (97.47)	14.40 (206.57)
SE±	0.04	0.17	0.18	0.04	0.18	0.29
CD (P=0.05)	0.11	0.40	0.40	0.11	0.44	0.70
Bio-fertilizer						
F1: Fertilizers @ 30:60:40 kg ha^{-1} $N:P_2O_5:K_2O$	2.36 (4.57)	5.88 (33.61)	8.90 (78.38)	2.35 (4.55)	6.17 (37.08)	9.29 (85.40)
F2: F1 + Rhizobium @ 250 g10 kg^{-1} seed	2.39 (4.72)	6.22 (37.73)	8.98 (79.78)	2.38 (4.68)	6.22 (37.73)	9.37 (86.82)
F3: F2 + Phosphate solubilising bacteria @ 5kg ha^{-1}	2.39 (4.74)	6.24 (37.94)	9.07 (81.32)	2.38 (4.70)	6.25 (38.18)	9.34 (86.35)
F4: F3+ Potassium solubilising bacteria @ 5kg ha^{-1}	2.40 (4.79)	6.30 (38.69)	9.08 (81.60)	2.41 (4.82)	6.33 (39.07)	9.43 (88.06)
SE±	0.04	0.20	0.24	0.04	0.19	0.24
CD (P=0.05)	NS	NS	NS	NS	NS	NS
Weed Management x Bio-fertilizer						
SE±	0.09	0.45	0.55	0.08	0.42	0.54
CD (P=0.05)	NS	NS	NS	NS	NS	NS

Data transformed to $\sqrt{x+1.0}$ and original values are in parentheses

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