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# Effect of crop establishment and weed management in wheat (*Triticum aestivum*)-greengram (*Vigna radiata*) crop sequence

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ABSTRACT

An experiment was conducted at SKRAU, Bikaner during 2016–18 comprising 28 treatments combinations having four crop establishment methods and seven weed management practices in a strip-plot design with four replications in wheat (*Triticum aestivum* L.) crop and its residual effect on succeeding greengram (*Vigna radiata* L.) crop was observed. Among crop establishment methods, stale seedbed (SSB)+ glyphosate 2.0 kg/ha significantly reduced the dry matter of weeds, viz. *Chenopodium album, Rumex dentatus, Cyperus rotundus* and *Cynodon dactylon* at all the stages, and increased the number of effective tillers, grain and straw yield of wheat to the tune of 8.02, 10.14 and 8.08, 10.28 and 8.09, 10.85 percent (%) in comparison to deep and conventional tillage, respectively. Metsulfuron methyl 4.0 g/ha + one hand hoeing registered the lowest dry matter of all the weeds except *Cyperus rotundus* and *Cynodon dactylon* at 60 DAS and harvest and it also produced the maximum number of effective tillers (105.75), spike length (6.26 cm), grains per spike (38.53), grain yield (3354 kg) and straw yield (4403 kg) over other herbicidal treatments. In succeeding greengram crop the weed dry matter was not significantly affected due to crop establishment methods except *C. rotundus* and *C. dactylon*. Yield of greengram was also not influenced by applied treatment in wheat.

**Keyword**: Glyphosate, Greengram, Metsulfuron methyl, 2, 4-D, SSB, Tillage

Wheat (*Triticum aestivum* L.) is an important crop as it contribute major portion of staple food for the world's rising population. Globally it contributes about 49% of food grain production. In India, wheat is grown on 30.6 m ha with total production of 98.38 mt and average productivity of 2961 kg/ha (Anonymous 2016a). In Rajasthan, wheat occupies prime place amongst all the cereal crops grown in the state, occupying 3.34 m ha area with 12.43 mt production and average productivity 3356 kg/ha (Anonymous 2016b). Infestation of weeds both annual and perennial is the important constraints in the low productivity of wheat. Weeds compete with crops for water, soil, nutrients, light and space; finally reduce crop yields (Das 2008). Verma *et al.* (2008) reported infestation of weed throughout crop growth period caused 43.63 (%) reduction in grain yield of wheat. Weed is one of the major biotic constraints in wheat production. Wheat is infested by diverse type of weed flora as it is grown different agroclimatic condition, tillage and irrigation regime, (Yadav and Malik 2005). There are several techniques that address the weeds issues before the sowing of crop and SSB technique is one of them. SSB technique is preventive method of weed management. This technique involves the soil preparation of a seed bed to promote germination of weeds, a number of days or weeks before the actual sowing or planting of the crop, thus depleting the seed bank in the surface layer of soil and reducing subsequent emergence of weeds (Rao *et al.* 2007). SSB technique yielded higher grain yield and the effect of weeding regime was significant on effective tillers, spike length and grain per spike and weeds suppression (Khatun *et al.* 2016). Herbicides play an important role for weed control in close spaced crops like wheat, where manual or mechanical weeding is difficult (Chhokar *et al.* 2012). Systematic research has not been conducted in arid climate of Rajasthan to determine feasibility of SSB technique in combination with herbicides and their effects on wheat yield and residual effect on succeeding summer greengram. Hence present investigation was carried out to evaluate the effect of SSB along with different tillage conditions and herbicides on weeds in wheat and their residual effect on succeeding summer greengram under North West Rajasthan conditions.

## MATERIALS AND METHODS

A field study was conducted during *rabi* 2016–17 and 2017–18 at Instructional Farm (28.01°N latitude and 73.22°E

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longitude at an altitude of 234.7 M amsl) of SKRAU, Bikaner. The soil was loamy sand, low in organic carbon (0.08%) and available N (78 kg/ha) and medium in available $P_2O_5$ (22 kg/ha) and available $K_2O$ (210 kg/ha) with *p*H 8.3. The treatments comprising 28 combinations having 4 crop establishment method (Stale seed bed (SSB) using shallow tillage, SSB using glyphosate 2.0 kg/ha, deep tillage and conventional tillage) and 7 weed management (Weedy check, weed free, one hand weeding at 30 DAS, 2, 4-D 0.5 kg/ha 30 DAS, metsulfuron methyl 4.0 g/ha, 2, 4-D 0.5 kg/ha 30 DAS + one hand hoeing and metsulfuron methyl 4.0 g/ha + One hand hoeing) was laid out in a strip plot design with four replications. Wheat variety 'Raj-3077' was sown at 22.5 cm row spacing using seed rate of 100 kg/ha. In stale seed bed technique, after seed bed preparation, the field was irrigated and left unsown to allow weeds to germinate and then killed by glyphosate and by carrying out shallow tillage prior to the sowing. Whereas, in deep tillage, disc plough and in conventional tillage, one harrow along with one cultivator was done. Metsulfuron methyl 4.0 g/ha and 2,4-D 0.5 kg/ha were applied as post emergence (30 DAS) in 500 litre water with the help of sprayer fitted with flat-fan nozzle. Weed dry matter was recorded at 30, 60 DAS and at harvest from 0.25 per square meter area by placing a quadrate of 0.5 × 0.5 m randomly at three places in each plot in wheat. In greengram weed dry matter accumulation was recorded at 30 DAS. Weeds were dried in oven till a constant weight was observed and then transformed into gram per square meter. Plant sample were collected of one meter row length for calculate the dry matter from each plot at 30, 60 and harvest stage. Plant sample were collected from net plot after harvest sun dried and weigh the each plot individually and converted into hectare. Total weed dry matter was subjected to square root transformation to normalize their distribution (Gomez and Gomez 1984). The standard error of mean (SE) and least significant difference (LSD) were worked out for comparing the treatment means of each of the studied variables of crops and weeds.

## RESULTS AND DISCUSSION

*Crop establishment methods*: SSB using glyphosate 2.0 kg/ha significantly decreased the dry matter of *Chenopodium album, Rumex dentatus, Cyperus rotundus* and *Cynodon dactylon* at 30, 60 DAS and harvest followed by SSB using shallow tillage (Table 1). The detrimental effect on weed dry matter might be due to the mortality of most of germinated seed, which were active in upper top soil layer, without disturbing the soil in comparison to deep and conventional tillage. The perennial weeds, i.e. *C. rotundus* and *C. dactylon* were difficult to control because of its re-germinating capacity, whereas adoption of SSB technique particularly using glyphosate 2.0 kg/ha significantly controlled these weeds this might be due to the fact that glyphosate destroyed reserve food material in its rhizomes by its systemic action (Kumar 2015). SSB using glyphosate 2.0 kg/ha recorded significantly higher dry matter accumulation at harvest, effective tillers, grain yield and straw yield than deep and conventional tillage that could be due to better weed control and comparatively higher growth which leads to higher yield attributing characters of wheat compared to deep and conventional tillage (Table 2). The increase in grain yield due to adoption of SSB using glyphosate 2.0 kg/ha was to the tune of 10.0 and 7.7% than deep and conventional tillage, respectively. These results are in agreement with the findings of Khatun *et al.* (2016) and Kumar *et al.* (2015).

*Weed management*: Metsulfuron methyl 4.0 g/ha + one hand hoeing was found the most superior treatment which controlled the weeds, viz. *C. album*, *R. dentatus, C. rotundus* and *C. dactylon* to the extent of 99.1, 98.8, 97.8 and 99.3%, respectively in comparison to weedy check at harvest (Table 1). This might be because of the fact that metsulfuron methyl 4.0 g/ha controlled *R. dentatus* more effectively and reduced the dry matter of the weed compared to 2,4-D 0.5 kg/ha. Regeneration of *R. dentatus* was noticed in 2,4-D 0.5 kg/ha applied plots and thus increased the dry matter of the weed as compared to metsulfuron methyl treatment. Both the herbicides failed in controlling perennial weeds, however, integration of these herbicides with one hand hoeing resulted in significant control of the perennial weeds. Amare *et al.* (2016) also reported similar results that integration of one hand hoeing with 2,4-D significantly reduced the dry matter of total weeds. Lowest dry weight of most of the broad leaved weeds, viz. *Chenopodium* species and *R. dentatus* and total weeds at 30, 60 DAS and harvest were observed under metsulfuron methyl 4 g/ha + one hand hoeing. Similar results were also observed by Singh *et al.* (2017).

Application of metsulfuron methyl 4.0 g/ha + one hand hoeing significantly increased the grain and straw yield over one hand hoeing at 30 DAS and 2,4-D 0.5 kg/ha. The increase in grain yield due to applied weed control measures like metsulfuron methyl 4.0 g/ha + one hand hoeing, 2,4-D 0.5 kg/ha + one hand hoeing and metsulfuron methyl 4.0 g/ha alone was to the extent of 102.1, 98.9 and 92.0% (%) than weedy check (Table 2). The lowest values of yield attributes and yield under weedy check may be due to severe competition by weeds for resources, which made the crop plant incompetent to take up more moisture and nutrients; consequently crop growth was adversely affected. Poor growth and less uptake of nutrients in weedy check might have produced less photosynthates and partitioned less assimilates to numerous metabolic sink and ultimately poor development of yield components. It was also supported by Patil *et al.* (2014) and Pisal *et al.* (2013).

Results indicated that most of weeds present in succeeding greengram were not significantly affected by crop establishment technique of wheat except C. *rotundus* and C. *dactylon* (Table 2). SSB using glyphosate 2.0 kg/ha had significant effect on dry matter of *C. rotundus* and *C. dactylon* that might be due to the effective control of these perennial weeds. These results corroborate the findings of Kumar *et al.* (2015). Adoption of crop establishment methods in wheat did not cause any significant variation in seed, straw and biological yield of summer greengram.

Table 1 Effect of crop establishment and weed management in wheat on weed dry matter accumulation (gram per square meter) at 30, 60 and harvest stage of crop (pooled data of two years)

| Treatment | *Chenopodium album* | | | *Rumex dentatus* | | | *Cyperus rotundus* | | | *Cynodon dactylon* | | | Total dry matter | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30 DAS | 60 DAS | At harvest | 30 DAS | 60 DAS | At harvest | 30 DAS | 60 DAS | At harvest | 30 DAS | 60 DAS | At harvest | 30 DAS | 60 DAS | At harvest |
| *Crop establishment method* | | | | | | | | | | | | | | | |
| ***SSB using shallow tillage | 1.45 (1.70) | 3.36 (21.97) | 7.08 (93.97) | 2.02 (3.90) | 3.20 (21.12) | 8.60 (131.4) | 1.51 (1.91) | 2.66 (9.90) | 2.51 (8.31) | 1.53 (1.97) | 3.25 (12.18) | 7.27 (89.48) | 3.01 (9.47) | 6.38 (65.34) | 13.79 (322.8) |
| SSB using glyphosate 2.0 kg/ha | 1.37 (1.46) | 3.03 (17.31) | 6.48 (78.90) | 1.84 (3.13) | 2.85 (15.55) | 8.19 (122.3) | 1.24 (1.08) | 2.10 (5.71) | 2.01 (4.85) | 1.07 (0.67) | 2.47 (6.49) | 6.03 (59.16) | 2.51 (6.34) | 5.31 (45.06) | 12.39 (265.2) |
| Deep tillage | 1.62 (2.27) | 3.84 (20.49) | 7.62 (108.53) | 2.28 (5.17) | 3.55 (25.80) | 9.50 (156.6) | 1.74 (2.70) | 2.88 (11.75) | 2.71 (9.69) | 1.61 (2.23) | 3.32 (12.77) | 7.99 (106.61) | 3.41 (12.36) | 7.03 (79.74) | 15.04 (381.4) |
| Conventional tillage | 1.70 (2.55) | 4.05 (32.21) | 8.22 (122.53) | 2.72 (7.63) | 3.84 (32.10) | 9.88 (169.5) | 1.82 (3.02) | 2.89 (11.82) | 2.81 (10.58) | 1.69 (2.52) | 3.57 (14.94) | 8.65 (126.83) | 3.82 (15.71) | 7.44 (92.02) | 15.95 (429.6) |
| SEm± | 0.01 | 0.05 | 0.08 | 0.02 | 0.06 | 0.05 | 0.01 | 0.03 | 0.02 | 0.01 | 0.03 | 0.11 | 0.02 | 0.12 | 0.15 |
| LSD (P=0.05) | 0.03 | 0.14 | 0.25 | 0.06 | 0.17 | 0.15 | 0.04 | 0.09 | 0.06 | 0.03 | 0.09 | 0.32 | 0.07 | 0.35 | 0.45 |
| *Weed management* | | | | | | | | | | | | | | | |
| Weedy check | 1.67 (2.32) | 11.37 (131.9) | 21.70 (476.5) | 2.51 (6.00) | 10.47 (112.38) | 24.83 (623.8) | 1.72 (2.55) | 4.56 (20.69) | 4.17 (17.23) | 1.61 (2.18) | 4.57 (21.03) | 15.09 (233.4) | 3.63 (13.04) | 16.71 (288.0) | 36.56 (1351.0) |
| Weed free | 0.71 (0.00) | 0.71 (0.00) | 0.71 (0.00) | 0.71 (0.00) | 0.71 (0.00) | 0.7 1() | 0.71 (0.00) | 0.71 (0.00) | 0.71 (0.00) | 0.71 (0.00) | 0.71 (0.00) | 0.71 (0.00) | 0.71 (0.00) | 0.71 (0.00) | 0.71 (0.00) |
| One hand hoeing at 30 DAS | 1.69 (2.41) | 4.47 (19.93) | 8.12 (66.42) | 2.49 (5.91) | 1.45 (1.60) | 10.24 (107.6) | 1.72 (2.54) | 2.75 (7.55) | 2.61 (6.75) | 1.59 (2.10) | 2.92 (8.18) | 5.71 (32.79) | 3.62 (12.96) | 6.08 (37.26) | 14.48 (213.5) |
| 2,4-D 0.5 kg/ha 30 DAS | 1.67 (2.31) | 4.04 (16.20) | 11.31 (128.8) | 2.41 (5.53) | 6.47 (42.71) | 14.51 (212.9) | 1.73 (2.55) | 4.53 (20.36) | 4.14 (16.96) | 1.60 (2.16) | 4.54 (20.74) | 14.05 (202.4) | 3.56 (12.55) | 9.90 (99.91) | 23.53 (561.1) |
| Metsulfuron methyl 4.0 g/ha 30 DAS | 1.66 (2.27) | 2.98 (8.63) | 4.99 (25.25) | 2.46 (5.73) | 3.03 (8.81) | 7.27 (53.85) | 1.71 (2.51) | 4.48 (19.95) | 4.13 (16.88) | 1.60 (2.16) | 4.50 (20.32) | 13.91 (196.8) | 3.58 (12.66) | 7.55 (57.71) | 16.97 (293.0) |
| 2,4-D 0.5 kg/ha30 DAS + One hand hoeing at 45 DAS | 1.67 (2.32) | 0.71 (0.00) | 2.47 (5.69) | 2.44 (5.57) | 0.71 (0.00) | 2.98 (8.50) | 1.72 (2.54) | 0.71 (0.00) | 0.89 (0.30) | 1.60 (2.15) | 2.50 (5.83) | 1.49 (1.77) | 3.58 (12.58) | 2.50 (5.83) | 4.08 (16.27) |
| Metsulfuron methyl 4.0 g/ha 30 DAS + One hand hoeing at 45 DAS | 1.68 (2.33) | 0.71 (0.00) | 2.17 (4.26) | 2.50 (5.96) | 0.71 (0.00) | 2.75 (7.16) | 1.72 (2.56) | 0.71 (0.00) | 0.94 (0.39) | 1.61 (2.18) | 2.35 (5.05) | 1.42 (1.56) | 3.63 (13.02) | 2.35 (5.05) | 3.71 (13.36) |
| SEm± | 0.01 | 0.09 | 0.08 | 0.03 | 0.08 | 0.06 | 0.01 | 0.03 | 0.03 | 0.01 | 0.05 | 0.11 | 0.03 | 0.21 | 0.15 |
| LSD (P=0.05) | 0.04 | 0.26 | 0.24 | 0.08 | 0.24 | 0.17 | 0.04 | 0.10 | 0.08 | 0.04 | 0.16 | 0.33 | 0.08 | 0.60 | 0.44 |

*Transformed to √x+0.5 , ** original values and *** SSB – Stale seed bed

Table 2 Effect of crop establishment and weed management on growth, yield attributes and yield of wheat and weed dry matter 30 DAS in greengram and yield of greengram (pooled data of two years)

| Treatment | Dry matter (g) at harvest | Effective tillers (MRL) | Spike length (cm) | Grain/ spike | Seed yield (kg/ha) | Straw yield (kg/ha) | Test weight (g) | *Cenchrus biflorus* | *Physalis minima* | *Tribulus terrestris* | *Cyperus rotundus* | *Cynodon dactylon* | Grain yield (kg/ha) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Crop establishment method* | | | | | | | | | | | | | |
| ***SSB using shallow tillage | 148.88 | 98.18 | 6.16 | 35.13 | 2967 | 3907 | 41.11 | 0.71 | 0.90 | 1.95 | 1.23 | 1.12 | 853 |
| SSB using glyphosate 2.0 kg/ha | 153.11 | 101.77 | 6.20 | 35.68 | 3130 | 4062 | 41.41 | 0.71 | 0.88 | 1.88 | 0.98 | 0.95 | 888 |
| Deep tillage | 144.64 | 93.61 | 6.13 | 33.54 | 2877 | 3733 | 41.11 | 0.74 | 0.90 | 2.06 | 1.29 | 1.17 | 830 |
| Conventional tillage | 140.80 | 91.45 | 6.10 | 33.73 | 2808 | 3621 | 40.63 | 0.77 | 0.94 | 2.08 | 1.35 | 1.22 | 808 |
| SEm± | 0.81 | 1.23 | 0.03 | 0.62 | 44 | 54 | 0.36 | 0.05 | 0.04 | 0.08 | 0.04 | 0.01 | 21 |
| LSD (P=0.05) | 2.39 | 3.65 | NS | NS | 131 | 161 | NS | NS | NS | NS | 0.12 | 0.03 | NS |
| *Weed management* | | | | | | | | | | | | | |
| Weedy check | 101.50 | 68.50 | 5.90 | 27.16 | 1678 | 2136 | 40.84 | 0.65 | 0.86 | 2.12 | 1.21 | 1.11 | 843 |
| Weed free | 161.75 | 107.41 | 6.29 | 39.81 | 3486 | 4596 | 41.78 | 0.79 | 0.91 | 1.89 | 1.18 | 1.09 | 876 |
| One hand hoeing at 30 DAS | 151.81 | 98.19 | 6.05 | 32.28 | 2971 | 3949 | 40.91 | 0.80 | 0.97 | 2.00 | 1.20 | 1.10 | 838 |
| 2,4-D 0.5 kg/ha 30 DAS | 145.53 | 89.00 | 6.12 | 31.91 | 2641 | 3387 | 40.53 | 0.62 | 0.88 | 2.04 | 1.25 | 1.13 | 833 |
| Metsulfuron methyl 4.0 g/ha 30 DAS | 152.63 | 100.75 | 6.20 | 35.00 | 3187 | 4021 | 41.16 | 0.73 | 0.91 | 2.04 | 1.24 | 1.14 | 837 |
| 2,4-D 0.5 kg/ha 30 DAS + One hand hoeing at 45 DAS | 156.75 | 104.16 | 6.23 | 36.94 | 3300 | 4323 | 41.38 | 0.84 | 0.98 | 1.95 | 1.23 | 1.13 | 835 |
| Metsulfuron methyl 4.0 g /ha 30 DAS + One hand hoeing at 45 DAS | 158.03 | 105.75 | 6.26 | 38.53 | 3354 | 4403 | 40.84 | 0.70 | 0.83 | 1.91 | 1.19 | 1.10 | 851 |
| SEm± | 1.78 | 2.26 | 0.03 | 1.06 | 41 | 91 | 0.50 | 0.06 | 0.05 | 0.11 | 0.02 | 0.01 | 24 |
| LSD (P=0.05) | 5.10 | 6.48 | 0.10 | 3.04 | 117 | 261 | NS | NS | NS | NS | NS | NS | NS |

These results corroborate the findings of Nithya and Chinnusamy (2015) and Singh (2015). Weed management treatments of wheat did not cause any significant variation in dry matter of weeds as well as seed, straw and biological yield of succeeding greengram (Table 2). Similar results were also reported by Singh *et al.* (2015) and Yadav *et al.* (2004).

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