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WEED CONTROL AND YIELD OF BEAN TREATED WITH SUNFLOWER RESIDUE

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Abstract: The application of crop residues is one of the recommended practices to improve soil conditions and through the release of allelopathic substances from the plant species used, helps to control weeds in crops. The objective of the study was to determine the effect of incorporating into the soil dried and ground sunflower receptacle from different crop years weed species, density and dry matter, and bean yield and components. The sowing of the bean cultivar Flor de Durazno of determinate growth habit type I was carried out under rainfed conditions on May 26, 2006 in a Fluvisol fertilized with 100-100-00 NPK in Montecillo, Mex. (19º 29' N, 98º 45' W, 2250 m altitude, temperate to semi-arid climate, at the density of 33 plants per m^2 in furrows of40 cm of separation. The treatments consisted of the incorporation to the soil 15 days before sowing of 3 kg m^{-2} of dry and ground sunflower receptacle (RG) from harvests 2003, 2004, the mixture of 2003 and 2004 and a control without application. The experimental design was randomized blocks with four replications. The incorporation of RG to the soil from different crop years reduced the population and the dry matter accumulation of the weeds. The species in order of importance value found in beans were *Simsia amplexicaulis* (Cav.)Pers, *Galinsoga parviflora* (Cav.), *grasses* within which were found *Bromus catharticus* Vahl, *Eleusine multiflora* Hochst.ex A. Rich, *Setaria adhaerens* (Forssk) Chiov, *Cynodon dactilon* (L.) Pers *and Eragrostis mexicana* (Horneum) Link *Chenopodium album* L., *Amaranthus hybridus* L.,*Portulaca oleracea* L. *Urocarpidium limense (L.) Krapovickas, Cyperus esculentus* L. *and Oxalis latifolia* Kunth Incorporation of GR from different crop years reduced the number of bean plants, increased the number of pods, seeds and yield per unit area.

Keywords: species, density, importance value, climate elements, Phaseolus vulgaris L. and yield components.

INTRODUCTION

The use of mulches, also called mulching, is a recommended practice to achieve greater water retention, higher organic matter content and reduction of soil erosion (Khanh *et al*., 2005). In addition, mulching can release phytotoxic or allelopathic compounds into the environment, creating unfavorable conditions for weed germination and establishment. Dhima *et al*. (2006) and Kobayashi *et al*. (2004) report that rye, barley and triticale mulch release phytotoxic substances into the environment and suppress weed germination and establishment in corn and soybean. However, this property is limited by environmental conditions and the cultivar used (Kobayashi *et al*., 2004). Atla Unión Europea mulching with crops is one of the recommended practices to improve soils. However, reports on the effect on weed emergence and growth under Mediterranean conditions are limited (Vasilakoglou *et al*., 2006). On the other hand, yield increases in soybean (*Glycine max* (L.)Merr), sugar beet *(Beta vulgaris* L.), maize (*Zea mays* L.) and cowpea (*Phaseolus vulgaris* L.) have been reported with mulching (Dhima *et al*., 2006; Haramoto and Gallandt, 2005; Kobayashi *et al*., 2004). Mangan *et al.* (1995), indicate that rye straw and *Vicia villosa* placed on the soil surface show weed control similar to a chemical herbicide. However, when they are incorporated into the soil, the same results are not observed. In sugarcane, Thakur *et al.* (1996) reported weed control, without affecting crop yield, with application of plant residues on the surface or between rows in sugarcane. Rambakudzibga (1991) reported that wheat mulch controlled only a few weed species and observed greater control with increasing mulch thickness. Likewise, Hassan *et al.* (1998) reported that the application of rice straw three months before planting cucumber (*Cucumis sativus* L.) is more effective for the control of grassy and broadleaf weeds (Olofsdotter *et al.*, 2002). Medrano *et al.* (1996), also in cucumber, mention weed control for 30 days, with a dead cover of5 cm thickness. Herrera *et al*. (2003) point out that the application of 5.6 tons of dry matter per hectare of rice straw on the soil drastically reduced the presence of grassy and dicotyledonous weeds. This effect is attributed to the fact that the straw on the soil releases allelopathic substances, causes less temperature fluctuation, reduces incident photosynthetically active radiation and favors greater moisture retention, which is reflected in higher bean yields. Rodriguez *et al*. (1998) have shown that incorporation of dried and ground sunflower receptacle into the soil reduces the weed population. However, little is known about the duration of the allelopathic properties of the receptacle for weed control. The objective of the present study was to determine the effect of soil incorporation of dried and ground sunflower receptacle from different crop years on: a) the species, number of plants, and dry matter of weeds occurring in the bean crop; and b) the yield and components of bean cv. Peach blossom.

MATERIALS AND METHODS

The sowing of bean (*Phaseolus vulgaris* L.) cultivar Flor de Durazno with determinate growth habit type I, pink seed color with beige background, size between 410-530 mg and protein content of 26 % (recommended by Campos *et al*., 1998 for Valles *Altos and rainfed conditions*) was carried out under rainfed conditions in May 2006 at Montecillo, Mexico (19º29' N, 98º98' W, 2250 m altitude). for Valles Altos and rainfed conditions) was carried out under rainfed conditions on May 26, 2006 in Montecillo, Mexico (19º29' N, 98º 45'W, 2250 m altitude, temperate to semi-arid climate, BS1 according to Garcia, 2004) at a density of 33 plants per m^2 (330,000 plants per ha), in furrows40 cm apart. The soil was Fluvisol type fertilized with 100-100-00 NPK. The treatments consisted of incorporating 3 kg m^{-2} of dried and ground sunflower receptacle from the 2003 harvest (R03), 2004 (R04), the mixture of 2003 and 2004 (R34) and a control without application (TEST) to the soil 15 days before bean planting. The experimental design was randomized blocks with four replications. During the crop cycle, the decennial average of maximum (Tmax) and minimum (Tmin) temperature (ºC), the decennial and seasonal sum precipitation, photosynthetically active radiation (PAR) and heat units or degree days development (GDD) (calculated using the residual method (Snyder, 1985) and taking a base temperature (TB) of 10ºC for beans) accumulated during the crop cycle were recorded. In a quadrat of 50 X50 cm for each experimental unit, we evaluated for weeds, the number of species and biomass production (dry matter) at 31 days after planting (DDS). The data are reported by m^2. In addition, relative density (number of individuals per species/number of individuals of all species)*100) and relative dominance (dry matter (DM) of individuals of one species/MS of individuals of all species)*100), and the importance value (VI, sum of relative density and relative dominance) were calculated for each experimental unit per treatment.) In beans, phenology (according to the criteria in Escalante and Kohashi,2024), grain yield (REND, dry matter (DM) weight, g) and its components were evaluated: number of seeds m-$^{(2)}$ (NS), seed size (TS, average DM per seed), Number of normal pods m^{-2} (NV, those containing at least one normal seed), number of clusters m^{-2} (RAC), the number of nodes m^{-2} (KNOTS) and the number of bean plants per m^{-2}. Analysis of variance and Tukey's mean comparison test were applied.

RESULTS AND DISCUSSION

CLIMATE ELEMENTS

Figure 1 shows that during bean development the Tmax ranged between 28 and32°C and Tmin between 2 and 9 °C, which are lower than the historical average of 25 years (Tmax 23.2 to 27.2 °C; Tmin 7.7 and 11ªC) and that could be limiting for the development of beans, since it has been reported as optimum temperature for photosynthesis 25°C (Jones, 1971) and base temperature for the physiological activity of this legume of 10°C. Precipitation was higher than10 mm decennial except for one period in the vegetative stage and two in the reproductive stage. During the period from grain filling to physiological maturity, the highest rainfall was recorded (between 15 and25 mm decennial). Also, in most of the crop cycle, evaporation was higher than precipitation, indicating that the crop was under a severe water deficit that consequently limited the growth and yield of beans and weeds that occur in this crop. Total accumulated precipitation during the growing season was 274 mm (6% below the historical average) and evaporation was 418 mm and crop ETc was 334 mm. Heat accumulation during the cycle was 826 °C days. The seasonal PAR was 899 MJ m-^{2}

MALEZA

DENSITY AND DRY MATTER

Treatments R04, R34 and R03 reduced weed density by 42%, 43% and 69%; and dry matter accumulation by 43%, 37% and 74%, respectively (Table 1). This suggests an effect of sunflower residue on weed germination and photosynthesis, which may be attributable to the release of allelopathic substances (Rodríguez *et al*., 1998), lower temperature fluctuation and reduction in incident photosynthetically active radiation (Medrano *et al.*, 1996; Herrera *et al*., 2003).

Treatment	Density (plants m-^{2})	Dry matter (gm-^{2})
Witness	235 a	61 a
R04	137 ab	35 bc
R34	134 ab	39 b
R03	73 b	15 c
Overall average	145	37
Prob.F	0.0054	0.0007
Tukey 0.05	101	21

Table 1. Density (number of plants m-($^{2)}$) and dry matter (g m-^{2}) of weed growing in bean (*P.vulgaris* L.) as a function of sunflower (*Helianthus annuus* L.) receptacle application. Average data from 16 replicates (without considering the species).

In columns values with similar letters are statistically equal (Tukey0.05).

As for the species, *Simsia amplexicaulis* (Cav.)Pers.,was the one that showed the highest density, dry matter accumulation, relative density, relative dominance and the highest importance value, surpassing *Galinsoga.parviflora* Cav. by 82%, 82%, 73%, 72% and 73%, respectively.The next group of grasses (including *Bromus catharticus* Vahl*, Eleusine multiflora* Hochst.ex A. Rich*, Setaria adhaerens* (Forssk) Chiov, *Cynodon dactilon* (L.) Pers *and Eragrostis mexicana* (Horneum) Link*)* and the lowest values corresponded to *Chenopodium. album* L., *Amaranthus hybridus* L.., *Amaranthus hybridus L., Amaranthus hybridus L., Amaranthus hybridus L., Amaranthus hybridus L., Amaranthus hybridus L., Amaranthus hybridus L., and Amaranthus hybridus L.*, were the most important, *Amaranthus hybridus* L. *Portulaca. Oleracea* L., *Urocarpidium limense (L.) Krapovickas, Cyperus esculentus* L. *and Oxalis latifolia* Kunth (Table 1). It should be noted that *Portulaca. Oleracea* L was not observed in the plots where sunflower residue was applied. These results suggest that weed management strategies should focus particularly on the control of *Simsia amplexicaulis* because of its higher importance value.

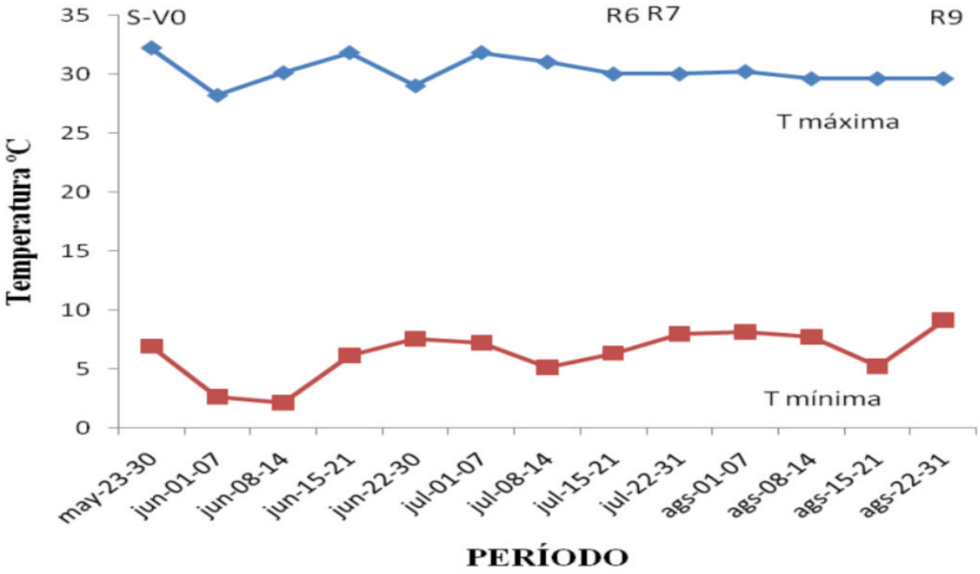

Figure 1.- Average maximum and minimum temperature during the development of the bean cv. Flor de Durazno under sunflower residue treatment in the soil. Montecillo Mex. Summer 2006.

S=sowing; V0=sprouting; V1=emergence; R6=start of flowering; R7=pod formation; R9=physiological maturity.

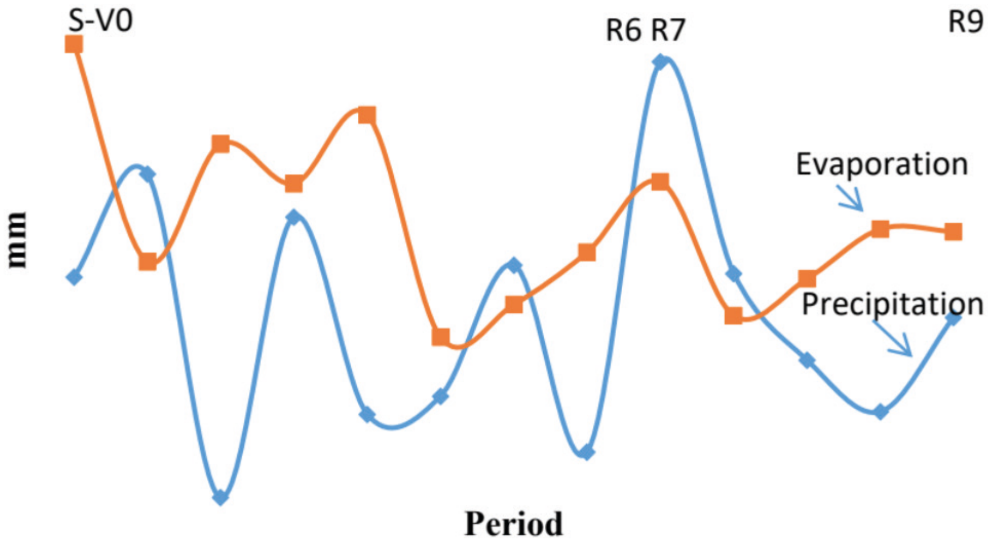

Figure 2.-Precipitation and evaporation (decadal sum) during bean (*P. vulgaris* L.) cv. Flor de Durazno under sunflower residue incorporation treatments. Montecillo, Mexico, summer 2006.

S=sowing; V0=germination; V1=emergence, R6=flowering initiation, R7= pod formation, R9=physiological maturity.

Species	Density (plants m-^{2})	Relative density (%)	Dry matter (g m-^{2})	Relative dominance (%)	Importance value (VI)
Simsia amplexicaulis	111 a	74	22 a	59	133
Galinsog parviflora	20 b	13	6 b	16	29
Gramineas	7 b	5	3 bc	8	13
Chenopodium album	4 c	3	3 bc	8	11
Amaranthu hybriduss	4 c	3	2 bc	5	8
Urocarpidium	2 c	1	0.5 bc	1	2
Portulaca oleracea	0.8 c	0.5	0.5 bc	1	1.5
Cyperus esculentus	0.5 c	0.25	0.2 c	1	1.25
Oxalis latifolia	0.25 c	0.25	0.12 c	1	1.25
Tukey 0.05	13		3		

Table 2. Density (number of plants m-($^{2)}$), dry matter (g m-^{2}), relative density, relative dominance and importance value of weed species growing in bean (*P.vulgaris* L.) as a function of sunflower (*Helianthus annuus* L.) receptacle application. Average data of 16 replications (without considering receptacle treatments).

In columns values with similar letters are statistically equal (Tukey0.05).

Treatment	Rend gm-^{2}	NS m-^{2}	TS mg	NV m-^{2}	RAC m-^{2}	KNOTS m-^{2}	PLANTS m-^{2}
R34	262 a	764 a	343 a	267 a	319 a	431 a	38 ab
R04	235 ab	696 ab	338 a	204 ab	222 ab	311 a	30 b
R03	92 b	274 ab	314 a	129 b	138 b	315 a	29 b
TEST	84 b	251 b	333 a	106 b	263 ab	487 a	45 a
Overall average	168	496	332	176	235	386	35
CV (%)	24	26	10	32	34	32	18
PROB. F.	0.01	0.01	0.64	0.01	0.05	0.19	0.018
Tukey (0.05)	162	506	0.72	126	181	278	14

Yield and components of bean (*Phaseolus vulgaris* L.) cv. Flor de Durazno as a function of sunflower receptacle application to the soil. Montecillo, Mex. Summer 2006.

In columns values with similar letters are statistically equal. Rend = seed yield; NS= number of seeds; TS= seed size (mean individual seed weight); NV= number of pods; RAC = number of clusters; KNOTS= number of knots; CV= coefficient of variation.

BEANS

PHENOLOGY

Bean phenology was similar among treatments. Emergence (V1) occurred at 8 DDS, flowering initiation (R6) at 52 DDS, pod formation (R7) at 63 DDS and physiological maturity (R9) at 100 DDS.

YIELD, ITS COMPONENTS AND NUMBER OF PLANTS

Table 2 shows that with the exception of NUDOS and TS, the rest of the yield components and the yield itself showed significant changes due to the effect of the treatments. In general, where sunflower residue was incorporated, a higher yield than the control was observed, possibly due to greater water retention and higher soil organic matter content (Khanh *et al.*, 2005), as was also found in soybean (*Glycine max* (L.)Merr), sugar beet *(Beta vulgaris* L.), maize *(Zea mays* L.) and cowpea (*Phaseolus vulgaris* L.) by Dhima *et al*. (2006); Haramoto and Gallandt (2005) and Kobayashi *et al*. (2004). The highest yield corresponded to the sunflower residue mixture from both years (treatment R34) with 262 g m-^{2} product of higher NS, NV and RAC, followed by R04 (235 g m-^{2}), R03 (84 g m-^{2}) and the control which showed the lowest yield (84 g m-^{2}), due to lower NS, NV and RAC. The yield of the bean with residue exceeded the control by 211% (R34), 180% (R04)and 9.5 % (R03). On the other hand, the crop with residue showed a lower number of plants, but higher NS and NV, which led to a higher yield (Table 2).within the sunflower residue treatments, one of the possible causes of the lower yield with R03 is that due to the longer storage time the material could have developed pathogens that affected the establishment of the population and consequently the bean yield

CONCLUSIONS

The incorporation of sunflower residues into the soil from different crop years reduces the population and dry matter accumulation of weeds occurring in beans. The weed species of highest importance value is *Simsia amplexicaulis*, followed in descending degree by *Galinsoga. parviflora,* the grass group, *Chenopodium. album, Amaranthus. hybridus ,Portulaca. oleracea, Urocarpidium limense, Cyperus esculentus. and Oxalis latifolia.* The highest number of pods, seeds and yield per unit area in beans is achieved with the incorporation of the mixture of the residue from the two years of study and the most recent harvest.

RECOMMENDATIONS

The incorporation of sunflower residues for weed control and to improve the yield of bean cv. Peach Blossom is suggested for conditions similar to those under which the present study was conducted.

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