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Interference of a weed community in the soybean crop in functions of sowing spacing[1]

Interferência de plantas daninhas na cultura da soja em função do espaçamento de semeadura

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ABSTRACT - The use of double row spacing on soybean crop is recent and consists of a new soybean production technology in Brazil and worldwide, so weed interference may be different in relation to single crop row. Thus, the objective of this work was to evaluate the weed interference in soybean crop in function of sowing spacing. The experimental design was randomized blocks and treatments were arranged in a factorial (2x16): two spacings, a double row spacing [(0.20 x 0.20 m) x 0.67 m] and a conventional single row spacing (0.45 x 0.45 m) and sixteen periods of weed management, being eight control periods in which soybean was kept free of weeds by increasing periods of 7; 14; 21; 28; 35; 42; 49 and 145 days after emergence and eight coexistence periods, when the crop was maintained in the presence of the weed community for the same periods. The Critical Timing of Weed Removal (CTWR) was lower in the double row spacing, with eight days, compared with single spacing that was of 18 days. The Critical Weed-Free Period (CWFP) was of 36 and 31 days for double and single row spacing, respectively, and the emergence of weeds after this period did not cause damage to the productivity, but the Critical Period of Weed Control (CPWC) was higher in double row spacing (28 days) compared to the single row, which was of 13 days. The spacing in double row had a higher grain yield than the spacing in single row.

Key words: Critical Periods. Phytosociology. *Glycine max.* Weed Competition.

RESUMO - A utilização de espaçamento de fileira dupla na cultura da soja é recente e constituem-se em uma nova tecnologia de produção de soja no Brasil e no mundo, com isso, a interferência de plantas daninhas pode ser diferentes em relação ao cultivo de linhas simples. Assim, o objetivo deste trabalho foi avaliar a interferência de plantas daninhas na cultura da soja em função do espaçamento de semeadura. O delineamento experimental utilizado foi em blocos casualizados e os tratamentos foram dispostos em esquema fatorial (2x16): dois espaçamentos, um espaçamento de fileira dupla [(0,20 x 0,20 m) x 0,67 m] e um espaçamento convencional de fileira simples (0,45 x 0,45 m) e dezesseis períodos de manejo de plantas daninhas, sendo oito períodos de controle em que a soja foi mantida livre das plantas daninhas por períodos crescentes de 7; 14; 21; 28; 35; 42; 49 e 145 dias após a sua emergência e oito períodos de convivência, quando a cultura foi mantida na presença da comunidade infestante pelos mesmos períodos. O Período Anterior a Interferência foi menor no espaçamento em fileira dupla (8 dias) quando comparado ao espaçamento simples (18 dias). O Período Total de Prevenção da Interferência foi de 36 e 31 dias para o espaçamento em fileira dupla e simples, respectivamente, sendo que a emergência de plantas daninhas após este período não reduziu a produtividade, porém o Período Crítico de Prevenção à Interferência foi maior no espaçamento em fileira dupla (28 dias) em comparação ao da fileira simples que foi de 13 dias. O espaçamento em fileira dupla apresentou uma produtividade de grãos superior ao de fileira simples.

Palavras-chave: Períodos Críticos. Fitossociologia. *Glycine max.* Matocompetição.

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INTRODUCTION

Crops are subject to productivity losses due to biotic and abiotic factors. Among the biotic factors is the presence of weeds that cause interference in the development of cultivated plants. This interference depends on the present species, on the emergence period of weeds in relation to the cultivated crop, on population density, cultural practices, on the length of coexistence and on the edaphoclimatic conditions present at the coexistence period. The main interference occurs by competition between plants for nutrients, light, water and space (CARVALHO; BIANCO; GUZZO, 2010; PITELLI, 1985; SILVA *et al*., 2013).

In agro-ecosystems management studies, the relevant assessments of the dynamics of weed communities are fundamental to understanding their influence on crops and the impacts on cultural practices. The crop can coexist for a period with the weed community without undergoing limitations on productivity, but there are periods in which the crop should remain free of weeds. These periods are called CTWR (Critical Timing of Weed Removal) and CWFP (Critical Weed-Free Period), respectively. The difference between them, the CPWC (Critical Period of Weed Control), determines the time when the weed management should be performed (PITELLI, 1985).

Alternatives in weed control include the use of cultural measures, such as reducing the spacing, so that the crop closes the canopy in between rows as quickly as possible and shade weeds (DALLEY; KELLS; RENNER, 2004). In the soybean crop, there are examples of reduced spacing that allowed gains in the time of control of weeds, such as the reduction from 0,5 m to 0,35 m, (BIANCHI *et al*., 2010). Besides the reduction in spacing, there are other alternatives such as seeding in double rows that allows plants to intercept greater amounts of light and reduce soil water loss by evaporation, which can lead to an increased crop production compared to the seeding in single rows (CALISKAN *et al*., 2007).

It is observed that some soybeans cultivars have high competitiveness with weeds and reduced row spacing provide early ground cover, reducing the population and the dry mass of weeds, with the possibility to increase grain yield (BIANCHI *et al*., 2010). The changes competitive is due to the phenotypic plasticity of plants adaptation to the conditions environment imposed, being the change of planting system a promising technology in countries like the United States and Brazil (RAMBO *et al*., 2003).

In the soybean cultivation system, when using row spacing of 0.5 m, the CWFP is 30 days and the CTWR is 10 days (MARTINS, 1994) or 17 days (SILVA *et al*., 2009). However, for the 0.45 m spacing the CWFP is 66 days and the CTWR is 33 days (NEPOMUCENO *et al*., 2007) or 10 days (CONSTANTIN *et al*., 2007). Agostineto *et al*. (2014) observed a 23-day CTWR and 50-day CWFP for the same 0.45-m spacing.the objective of this research is to study the interference of the weed community in soybeans in functions of sowing spacing comparing single and double rows and to estimate the critical period of interference prevention in both systems.

MATERIALS AND METHODS

This field study was installed and conducted in the agricultural year 2011/2012. The experimental area has the following geographical coordinates: 22°07’56’’ S and 74°66’84’’ WGr, with an average altitude of 762 m, average annual rainfall of 1,517 mm and average temperature of 26 °C.

The soil of the experimental area was classified as Structured Red Nitosol (EMBRAPA, 2013). The soil chemical analyzes were performed in the laboratories of the Faculty of Agronomy of UNESP, Botucatu/SP, Brazil. The soil chemical characteristics were: Ca ($mmol_c$ dm^{-3}) = 33.0; Mg ($mmol_c$ dm^{-3}) = 15.0; P_{resin} (mg dm^{-3}) = 32.0 and K ($mmol_c$ dm^{-3}) = 4.0. The experimental area was in fallow for six months before sowing. The soil tillage consisted of plowing and harrowing 15 days before sowing and another harrowing at the day before the sowing..

It was used the soybean cultivar MSOY 7908RR and planting was mechanized. The sowing fertilization was performed according to the soil analysis and it was used 400 kg ha^{-1} of the formula 2-20-20 (NPK) in the sowing row. Seeds were sown in two spaces, one in double row and another in single row. The plots related to spacing on double row [(0.20 x 0.20m) x 0.67 m] were composed of eight rows 5.0 m long, with a useful area of 6.96 m². Yet in the single row spacing (0.45 x 0,45m) the plots consisted of six rows 5.0 m long, with a useful area of 7.20 m². For the control of pests and diseases was used Thiamethoxam+lambda-cyhalothrin at 200 mL ha^{-1}; deltramethrin at 250 mL ha^{-1}; pyraclostrobin+epoxicona zole at 500 mL ha^{-1}, and azoxystrobin+cyproconazole at 300 mL ha^{-1}.

The treatments tested to study the weed community were divided into two groups: (i) a first group consisted of increasing periods of coexistence of the crop with the weeds (plots held in the bush) since soybean emergence. At the end of each coexistence period, the weeds present in the plots and those who subsequently came to emerge were eliminated by manual hoeing in between rows and weeding near the sowing row, and (ii) in the second group of treatments, the procedure was the opposite, that is, the crop remained free of weeds (plots kept in clean) since the emergence to different periods of its development cycle. After these times, the weeds that emerged were allowed to grow freely until the crop harvest. In this case, the weed control was also obtained by manual hoeing.

The experimental design was randomized blocks with four replications and the treatments were arranged in a factorial scheme (2 x 16), in which the A factor consists of two spacings (double and single row) and the B factor of sixteen management periods of weeds. Thus, the control and coexistence periods that constituted the treatments were: 0 days (control in the bush or clean), 0-7 days, 0-14 days; 0-21 days; 0-28 days; 0-35 days; 0-42 days and 0-49 days in clean or in the bush. Therefore, the experimental treatments consisted of eight increasing periods of coexistence or control of weeds since the emergence of the soybean crop.

At the end of the period of coexistence and control of weeds, it was made the list of the weed community through four subsamples of 0.5 m x 0.5 m ($1m^2$) in the useful area of each plot. In each sampling the plants were collected, identified, separated by species, quantified, packed in paper bags and then dried in an air forced renewal greenhouse at 70 °C ± 5 °C until constant mass. The evolution of dry mass accumulation by weed communities was studied through regression models.

At 145 DAE (days after emergence), being the soybean plants at the phenological stage R8, they were harvested. At harvest it were collected ten plants randomly within the useful area of each plot for evaluation of the following characteristics: plant height, number of pods per plant and number of grains per plant.

Soybean plants of the four central rows of 4.0 m in each plot were harvested for grain yield analysis through a plot automotive harvester and ZÜRM mechanical. After the track, grains were packed in paper bags, properly identified, and taken to the laboratory where it were made the determinations of grain yield, mass of 100 grains and determination of moisture. Productivity, in kg ha^{-1}, was adjusted to 13% moisture.

The period before weed interference on soybean crop was estimated on the basis of productivity data. The analysis of these data was processed by non-linear models, Boltzmann sigmoidal model:

$$y = \frac{(A_1 - A_2)}{1 + e^{(x - x_0)/d_x}} + A_2$$

Where, y: indicates estimated soybean yield, expressed in t ha^{-1}, based on the coexistence periods; x: indicates upper limit of the coexistence period (days); x_0: indicates upper limit of the coexistence period that corresponds to the intermediate value between maximum and minimum production; A_1: indicates maximum production, expressed in t ha^{-1}, obtained in the plots kept in control throughout the cycle; A_2: indicates minimum production, expressed in t ha^{-1}, obtained in the plots maintained in coexistence throughout the cycle; A_1-A_2: indicates loss of production, expressed in t ha^{-1}; d_x: indicates parameter indicating speed of loss or gain of production (tg α at the point x_0 and indicates the speed of loss or gain of production t ha^{-1} day^{-1}).

From this analysis, a regression curve was obtained, whose graphic expression indicates the soybean yield (y-axis) as a function of days of the agricultural cycle of crop (x-axis). The limits of the period before interference studied was estimated tolerating 5.0% loss in productivity obtained in the plots kept in clean throughout the cycle.

Thus, it were determined the CTWR - Critical Timing of Weed Removal (depending on periods of coexistence) and the CWFP - Critical Weed-Free Period (depending on control periods), and the CPWC - Critical Period of Weed Control was estimated between the ends of the CTWR and CWFP.

The data of weeds density and agronomic characteristics evaluated were submitted to analysis of variance by F test and the means were compared by Tukey test at 5% probability. These analyzes were performed with the help of the software SISVAR 5.1 (FERREIRA, 2011).

RESULTS AND DISCUSSION

The experimental area weed community consisted of 21 weed species belonging to twelve botanical families, with fourteen eudicotyledonous species [*Amaranthus hybridus* L., *Alternanthera tenella* Colla, *Acanthospermum hispidum* DC., *Bidens pilosa* L., *Emilia fosbergii* Nicolson, *Galinsoga parviflora* Cav., *Raphanus sativus* L., *Ipomoea grandifolia* (Dammer) O' Don, *Euphorbia heterophylla* L., *Chamaesyce prostrata* (Ailton) Small, *Sida rhombifolia* L., *Oxalis latifolia* Kunth, *Portulaca oleracea* L., and *Richardia brasiliensis* Gomes] and seven monocots species [*Cenchrus echinatus* L., *Digitaria nuda* Schumach, *Eleusina indica* (L.) Gaertn, *Brachiaria decumbens* Stapf., *Brachiaria plantaginea* (Link) Hitchc., and *Commelina benghalensis* L.].

All species found in the experimental area can be considered ruderal. According to Grime (2001) criteria, this is due to rapid germination, short development cycle, rapid seed production and high resource partition in reproduction structures. These species can be extremely aggressive in competition with agricultural crops.

The weed community population density was increased until 14 days after emergence (DAE), when 188 and 213 plants m^{-2} in the double and single row spacing, respectively (Figure 1), were observed. According to Silva and Durigan (2006), plants with high emergence and early growth speed have priority in utilizing environment resources and, therefore, usually have an advantage in their use. From 14 DAE, weed reduction occurred in both spacings, so that, at 35 DAE, there was lower number of plants when compared with the initial period. This suggests density decrease due to crop growth with the death of less competitive weeds.

At 42 DAA, there was a new increase in the number of plants, which was observed for both row spacings. At 49 DAE, the highest weed density was observed for the double row spacing, with 276 plants m^{-2}, and 166 plants m^{-2} for the single row spacing (Figure 1). The population increase observed in the first quarter of the soybean crop cycle can be attributed to pioneer plants uneven germination flow, which is characteristic of ruderal plants (GRIME, 2001). After half of the cycle, intense competition established between weeds promoted less competitive individuals high mortality rates, as observed by Rodrigues *et al*. (2010).

Individuals density increase in later double row assessments compared to simple rows may be related to greater spacing between soybean plants. At 145 DAE, weed density observed in the two spaces was lower than all studied periods. This was mainly due to the crop shading on the weed community, which was higher in the double row spacing, suggesting that weeds had higher emergency in this spacing because they had a greater spacing to develop.

According to Guilherme (2000), a considerable reduction in species growth, both in intra and interspecific combinations, is the result of space competition between plant groups that occupy the same location in a given period of time. Possibly, this was what happened in most of the control and coexistence periods studied in the simple row spacing, which showed a lower weed density when compared to the double row spacing.

After weeds manual weeding in the respective control period treatments, plots had lower weed emergence (Figure 2), being lower than the observed data for coexistence periods (Figure 1). Perhaps this is because manual weeding breaks the weeds present in the experimental area flow germination. Within control periods, simple row spacing showed little variation in all periods, ranging from 17.5 to 25.5 plants m^{-2}. In the double row spacing, plant density was higher in all assessed periods in relation to the simple row (except for 49 DAE), with the highest value being found at 35 DAE, with 45.0 plants m^{-2}. In the simple row spacing, the highest density was observed at 49 DAE, with a total of 26.0 plants m^{-2}.

Weeds found in double row spacing, in function to the control periods, presented high dry matter accumulation at 7 DAE. However, there was a decrease with soybean crop development until 49 DAE (Figure 3a). Pitelli (1985) reports that soil shading is an important crop control tool against weeds. Possibly, this also occurred for single row spacing. However, the greatest dry matter accumulation was observed when weeds were weeded at 7 and 14 DAE,

Figure 1 - Weeds average density in periods of coexistence with the soybean crop, in two spaces: double row [(0.20 x 0.20m) x 0.67 m] and single row (0.45 x 0.45m) spacing

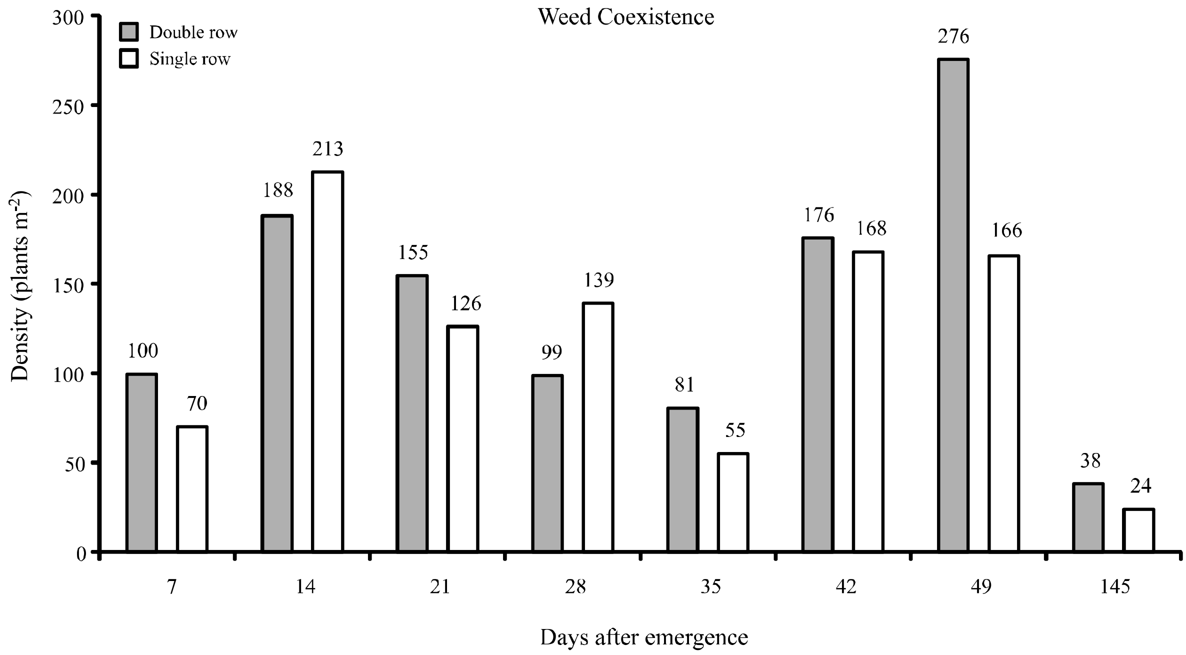


Figure 2 - Weeds average density in periods of kept free of weeds with the soybean crop, in two spaces: double row [(0.20 x 0.20m) x 0.67 m] and single row (0.45 x 0.45m) spacing

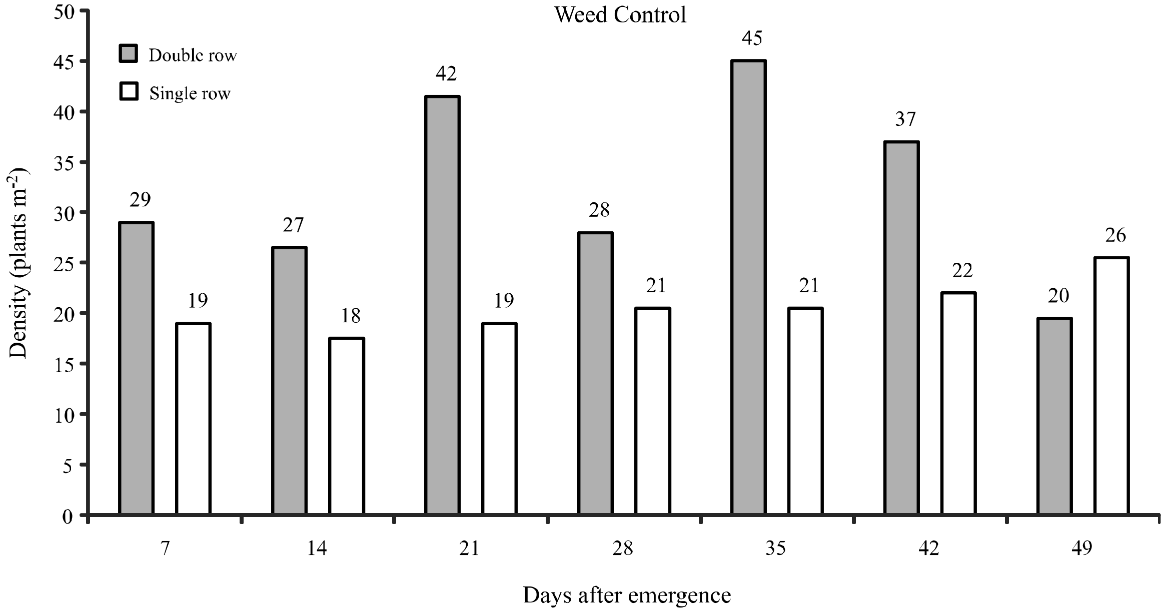
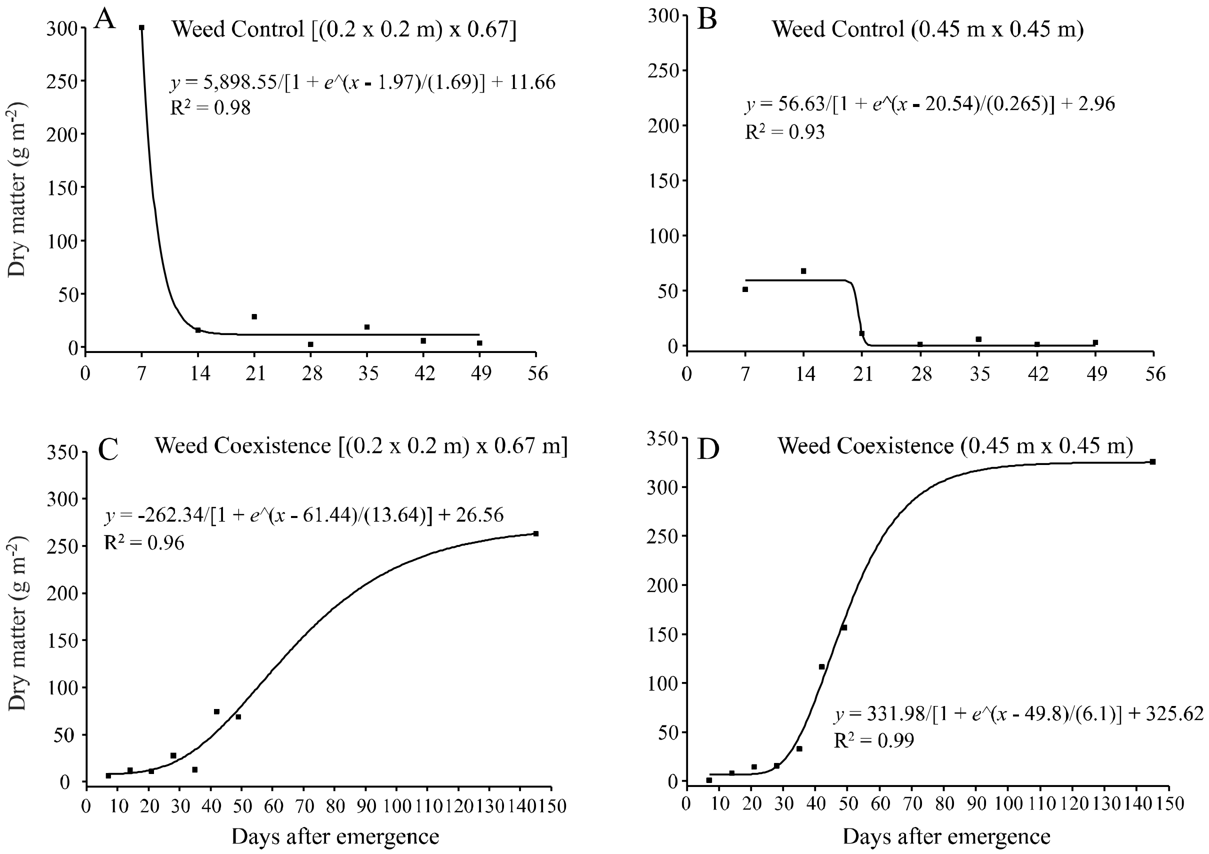


Figure 3 - Weeds dry matter in periods of coexistence and kept free of weeds with the soybean crop, in two spaces: double row [(0.20 x 0.20m) x 0.67 m] and single row (0.45 x 0.45m) spacing



with accumulation being lower than the one registered on double row spacing. Weeds that emerged in this period after hand weeding were maintained in coexistence with the crop until the end of the cycle, suggesting that the shading between rows was slower in the soybean crop double row spacing. Thus, for the remaining studied control periods, dry matter gradually and slowly decreased, probably due to the shading crop itself (Figure 3b).

There was weed community dry matter reduction as the control period increased, with reduction speed of 1.69 g m^{-2} day^{-1} of control for single row spacing, while this reduction was of 0.265 g m^{-2} day^{-1} for double row spacing. This fact showed that the interference imposed by the crop on the weed community was more quickly observed to the single row spacing when compared to the double row spacing.

Weed coexistence behavior in the two spacings was similar (Figure 3c and d). However, the final dry matter accumulation in the weeds observed in double row spacing was lower than that observed in single row spacing. The importance of spacing reduction is, in part, in the shading precocity promoted by the crop. According to (PITELLI, 1985), although interference between populations is already occurring when population succession takes place in an environment by the number of present plants, available resources in the medium are still higher than the demand. This would explain weeds dry matter increase in coexistence periods.

At 49 DAE, accumulation was more intense in the two studied spacing, and accumulation was higher in single row spacing. This occurred at 145 DAE, reaching the maximum value (263.1 and 325.5 g m^{-2} for double and single row spacing, respectively).

Weeds dry matter accumulation in the different coexistence periods reached maximum accumulation to 145 DAE. It is important to clarify that sampling carried out only in increasing control periods were made at harvest. Therefore, they show the of the weed community evolution condition during the soybean crop cycle. Sampling during this period provided weed community characterization after interspecific competition intensification. The highest plants and some seedlings that emerged on soybean natural defoliation stood out at the end of the agricultural cycle.

Regarding the studied soybean crop characteristics, it was noted that plant height was not affected by weed community coexistence and control periods, what was similar to that observed by Martins (1994) and Nepomuceno *et al*. (2007), being only affected by assessed spacings. However, number of pods per plant, number of grains per plant and grain yield variables were affected by both weed community coexistence and control periods and soybean studied spacings (Table 1).

Soybean plants showed higher height when cultivation took place in simple row spacing compared to the double row spacing. Probably, this is because this row spacing has less influence on intraspecific competition. Plants grown in double row spacing had this competition type increased, with a decrease of 6.3% of their height.

When assessing number of pods per plant, it was observed that the control kept in the bush until harvest, at 145 DAE, had fewer pods compared to control periods at 14, 28 and 49 DAE, with a mean reduction of these periods of 38.6%. Reducing the number of pods per plant is the main soybean yield component affected by weed interference (MARTINS, 1994). Number of pods per plant was lower in single row spacing, while there was pod production increase of 36.9% in double row spacing.

The number of grains per plant only showed reduction for the control kept in the bush, statistically differing from control periods (14, 28 and 49 DAE in clean). This was similar to what happened for the number of pods per plant, probably because they were related. Thus, mean reduction in these periods was of 40.5%. It is noteworthy that the number of grains per plant was also higher in the double row spacing than that found in single row spacing, with a similar increase to that observed for the number of pods, 36.8% (Table 1).

Number of grains per plant is often not affected by weed community interference (MARTINS, 1994), what has not corroborated the results found, as decreases were found in the control kept in the bush. There was also an increase in the number of grains per plant in the double row spacing, considering that it was because a higher number of pods and a higher number of grains per plant were also found in this larger spacing between double rows.

Soybean crop had a 7.6% higher grain yield in double row spacing compared to the single row spacing. This fact was probably due to the higher use of solar radiation in this spacing, which caused an increase in the number of pods and grains per plant (Table 1). In general, grain yield is related to plant population variation, and these are correlated with the number of pods $plant^{-1}$ and the number of grains per pod (MARTINS, 1994).

Productivity increases were registered as control periods advanced, with the largest grain yield obtained with the crop in the total weed absence, with a mean of 2917 kg ha^{-1}. Productivity percentage difference achieved by the control kept in clean compared to the control kept in the bush was of 27.2%.

Factors that influence competitiveness are varied. Among them, there is the spacing between rows. For the Critical Timing of Weed Removal (CTWR), values found for the two spacings were considered close to those

Table 1 - Plant height, number of pods, number of seed per plant and grain yield mean values, obtained in the main variables degrees of freedom unfolding

Variable	Height (cm)	Number of pods plant^{-1}	Number of seeds plant^{-1}	Grain Yield (kg ha^{-1})
		Spacing		
Double row	97.3 b	58.2 a	126.4 a	2745 a
Single row	103.9 a	42.5 b	92.3 b	2537 b
		Weed Control Periods		
0-07 days	110.5	47.2 ab	103.7 ab	2393 cd
0-14 days	98.6	56.8 a	127.4 a	2531 abc
0-21 days	101.1	48.5 ab	108.1 ab	2651 abc
0-28 days	100.8	56.5 a	121.0 a	2707 abc
0-35 days	103.5	54.1 ab	115.9 ab	2733 abc
0-42 days	98.6	47.4 ab	102.7 ab	2835 ab
0-49 days	100.5	56.7 a	123.8 a	2859 ab
0-harvest (weedy)	105.3	34.8 b	73.8 b	2125 d
		Weed Coexistence Periods		
0-07 days	101.2	53.8 ab	111.4 ab	2836 ab
0-14 days	102.1	52.5 ab	111.5 ab	2706 abc
0-21 days	100.6	51.0 ab	108.4 ab	2640 abc
0-28 days	98.8	51.2 ab	114.0 ab	2642 abc
0-35 days	98.4	47.8 ab	104.6 ab	2582 abc
0-42 days	100.3	47.9 ab	106.1 ab	2602 abc
0-49 days	98.9	46.9 ab	100.9 ab	2500 bcd
0-harvest (weed free)	100.2	52.4 ab	115.6 ab	2917 a
F BLOCK	3.93*	0.17^{ns}	0.18^{ns}	0.76^{ns}
F SPACING (S)	37.26**	62.93**	59.38**	27.46**
F PERIOD (P)	0.74^{ns}	1.90*	1.89*	6.13**
F (S) x (P)	1.21^{ns}	1.02^{ns}	1.08^{ns}	0.57^{ns}
C.V. (%)	6.1	22.1	22.9	8.5
LSD(S)	2.16	3.91	8.78	78.89
LSD(P)	10.84	19.62	44.07	395.84

Means followed by same letter in the column do not differ by Tukey test ($p<0.05$). **Significant at 1% probability; *Significant at 5% probability; ^{ns}not significant

observed by Melo *et al.* (2001). However, CTWR was lower in the higher spacing between rows (double row spacing) when compared to the single row spacing. Possibly, this occurred due to the higher weed density offered by wider spacing. CTWR value for double row spacing was of eight days (Figure 4), while CTWR was of eighteen days in the single row spacing (Figure 5). It is noteworthy that the crop was in early development stages in this period (formation of the first trifoliate). However, even at this early crop development stage, a weed interference process on soybean plants was already established.

CTWR corresponds to the early development cycle period when crop and weed community can live together for a certain period without harmful effects occurrence on the cultivated species productivity. Interference effects are irreversible, with no development or productivity recovery after removal of the stress caused by weeds presence. According to Meschede *et al.* (2004), considering weed management, CTWR becomes the cultural cycle period of greatest importance, from which productivity is significantly affected.

Figure 4 - Soybean yield dependent on increasing periods of coexistence and control in the double-row spacing [(0,20 x 0,20m) x 0,67 m]. CTWR (Critical Timing of Weed Removal) is the period before interference; CWFP (Critical Weed-Free Period) is the total period of interference prevention; and CPWC is the Critical Period of Weed Control

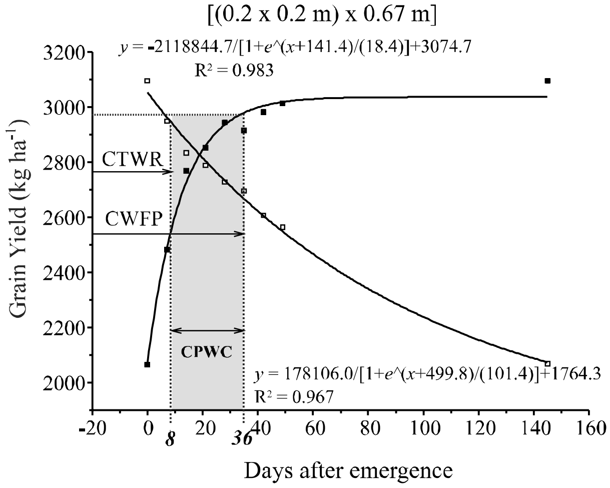
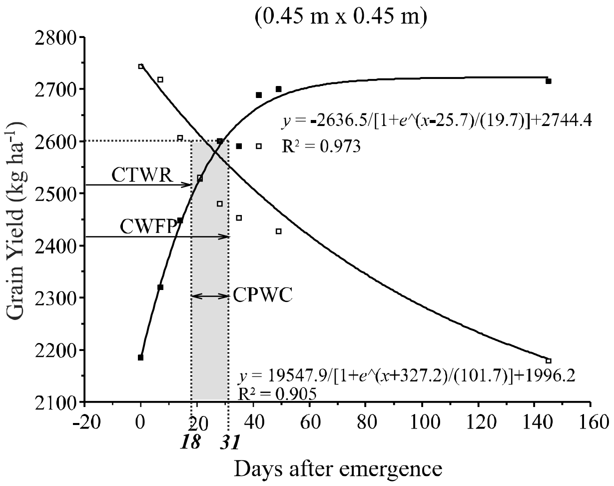


Figure 5 - Soybean yield dependent on increasing periods of coexistence and control in the double-row spacing (0,45 x 0,45m). CTWR (Critical Timing of Weed Removal) is the period before interference; CWFP (Critical Weed-Free Period) is the total period of interference prevention; and CPWC is the Critical Period of Weed Control



Several researchers point out that CTWR is between 10 and 33 days after soybean emergence (CONSTANTIN *et al.*, 2007; NEPOMUCENO *et al.*, 2007; SILVA *et al.*, 2009). Melo et al. (2001), when studying weeds interference in soybean crop, UFV-16 cultivar, planted in two spacing (30 and 60 cm) determining a CTWR of 7 and 18 days, respectively, assuming a loss of 2.0%. It is noteworthy that there was no double row spacing interference periods research in the consulted literature.

When analyzing equation parameters, it was observed that, for double row spacing (Figure 4), there was productivity loss speed of 101.43 kg ha^{-1} day^{-1} with coexistence periods. Gains were of 18.39 kg ha^{-1} day^{-1} with control periods, therefore being higher. When analyzing weed interference on control periods, it can be observed that their emergence from 36 to 31 days has not resulted in increased productivity for double and single row spacing, respectively (Figure 4 and 5), with these values corresponding to the CWFP.

The sigmoidal model biologically explains the relation between coexistence and control periods and soybean yield (NEPOMUCENO *et al.*, 2007). Therefore, the CPWC comprises the period of 8 to 36 days and 18 to 31 days, with double and single row spacing crop cycles being of 28 and 13 days, respectively. In this case, the soybean crop was more competitive against weeds on single row spacing compared with the double row spacing. Therefore, weed control should be performed throughout the CPWC (KOZLOWSKI; KOEHLER; PITELLI, 2009), avoiding higher than 5% losses in soybean commercial productivity.

Thus, with the regression equations, it can be inferred that weed community presence throughout the agricultural crop cycle can provide higher than 35.0 and 20.0% losses for double and single row spacing, respectively. Overall, the soybean crop was more competitive in the single row spacing due to crop faster closure. However, increased productivity in double row spacing should be followed by an efficient weed control, because this spacing has a CTWR of eight days, then weed interference starts faster than in single row spacing.

CONCLUSION

Double row sowing increases soybean yields. However, weed control should be extended for a longer period of time, since weed growth and development are more intense this spacing arrangement in relation to the single row spacing.

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