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Critical period of weed competition in cowpea

Período crítico de competencia de arvenses en fríjol caupí

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Rottboellia cochinchinensis.

Photo: C. Vergara-Córdoba

ABSTRACT

Weed competition is one of the factors that limit cowpea production in the world, causing losses of up to 90% of grain yield and quality. Knowledge of the critical period of weed competition (CPC) is important to prevent significant losses of grain and resources in the production process. The objective was to determine the critical period of weed competition in the cultivation of cowpea beans, Missouri cultivar, in two sowing seasons: dry (2022B) and rainy (2023A) of warm dry Colombian Caribbean. The randomized complete block design was used with eight treatments and four repetitions. The first four treatments corresponded to manual control of weeds in the intervals 0-10, 0-20, 0-30 and 0-50 days after emergence (DAE), the second four treatments corresponded to the crop-weed coexistence, in the same intervals. Cowpea grain yield, dry mass, cover and weed community composition were evaluated. The critical period of competition of weeds in the cowpea crop for the dry and rainy seasons was 14-33 and 14-29 days after emergence, respectively. The reduction in grain yield was 65.2% in the dry season and 80.46% in the rainy season. *Rottboellia cochinchinensis* had the highest occurrence rate with 30.3% and a density of 90 individuals per m^2; which is important for the agronomic management of the crop in the humid Caribbean subregion.

Additional key words: *Vigna unguiculata* (L.) Walp.; weed control; interference; yield; dry and rainy season.

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RESUMEN

La competencia con arvenses es uno de los factores que limitan la producción del fríjol caupí en el mundo, causando pérdidas de hasta 90% del rendimiento y calidad de grano. El conocimiento del periodo crítico de competencia de las arvenses es importante para prevenir pérdidas significativas de grano y recursos en el proceso productivo. El objetivo fue determinar el periodo crítico de competencia de las arvenses en el cultivo de fríjol caupí, cultivar Missouri, en dos estaciones de siembra: seco (2022B) y lluvioso (2023A) del Caribe colombiano cálido y seco. Se utilizó el diseño bloques completos aleatorizados con ocho tratamientos y cuatro repeticiones. Los primeros cuatro tratamientos correspondieron al control manual de arvenses en los intervalos 0-10, 0-20, 0-30 y 0-50 días después de la emergencia (DDE), los segundos cuatro tratamientos correspondieron a la coexistencia cultivo-arvense, en los mismos intervalos. Se evaluó el rendimiento de grano del caupí, y masa seca, cobertura y composición de la comunidad de arvenses. El periodo crítico de competencia de las arvenses en el cultivo de fríjol caupí para la estación seca y lluviosa fue de 14-33 y 14-29 DDE. La reducción del rendimiento de grano fue de 65,2% en la estación seca y de 80,46%, en la estación lluviosa. *Rottboellia cochinchinensis*, fue la de mayor índice de ocurrencia con 30,3% y densidad de 90 individuos por m^2; lo cual es importante para el manejo agronómico del cultivo en la subregión Caribe húmedo.

Palabras clave adicionales: *Vigna unguiculata* (L.) Walp.; control de arvenses; interferencia; rendimiento; temporada de sequía y lluvia.

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INTRODUCTION

The cowpea bean (*Vigna unguiculata* [L.] Walp.) is native to Africa and India, with Sub-Saharan Africa (Nigeria) being the main producer (Xiong *et al*., 2016; Carvalho *et al*., 2017). It is an important species in the agriculture of Colombia's Caribbean region; its resilience to adverse environmental conditions and its plasticity have allowed its cultivation in the different semi-arid areas of the tropics, it withstands drought and high temperatures; it is harvested early and has the advantage of incorporating atmospheric nitrogen due to its mutualistic symbiosis with *Rhizobium* sp. (Simunji *et al.*, 2019). In addition, green pods and seeds are an important source of fiber, carbohydrates, vitamins, proteins and minerals, with the percentage of protein reaching up to 28%, iron 54.6 mg kg^{-1}, zinc 52.6 mg kg^{-1} and phosphorus 4.3 mg kg^{-1} (Cardona-Villadiego *et al*., 2021), it is an especially important crop for vulnerable populations (Márquez-Quiroz *et al*., 2015), particularly when mineral malnutrition is considered a global challenge for humanity (WHO, 2024).

The cowpea cultivated areas in the Caribbean region of Colombia increased from 14,361 ha in 2007 to 17,199 ha in 2020 and, only for the Department of Cordoba, areas changed from 710 ha to 1,572 ha in 2022, with increasing yields, from 0.9 to 1.4 t ha^{-1} (MinAgricultura, 2024). The increase is based on the availability of varieties with greater potential for grain yield and nutritional quality. However, there are still technological limitations related to biotic and abiotic factors. Among them, weeds are a major problem in crops, because they can cause yield losses of up to 90%, in addition to increasing harvesting costs and decreasing grain quality (Cerna and León, 2015; Campos *et al*., 2023).

The weeds in cowpeas, in addition to competing for light, space, nutrients and water, are hosts for pests and diseases, and produce allelopathic substances that affect the production and quality of the grain (Lacerda *et al*., 2020). In addition, numerous weeds can seed production simultaneously with the crop's maturation, leading to contamination of the seeds at harvest time (Pessôa *et al*., 2015).

The level of weed interference can vary from region to region and depends on the composition, density and distribution of weeds, as well as the species, genotype, agronomic management, and the competence time between the cultivated species and the weeds (Vitorino *et al*., 2017; Scavo and Mauromicale, 2020; Medeiros *et al*., 2021).

To effectively control weeds, it is necessary to know the critical period of competition (CPC) between them and the crops. This is understood as the minimum time that the crop must be free of weeds to prevent significant yield losses and it also defines the optimal time to carry out weed control tasks (Hernández-Ríos *et al.*, 2022). Furthermore, Silva *et al*. (2015) have defined the critical period of interference prevention as the phase in which effective weed control must be adopted to prevent losses in productivity. This period is established from the construction of two complementary functions: the first involves studying the effect of the weeds that emerge along with the crop, which are the ones that have the greatest impact on the determination of yield and allow the establishment of the onset of the CPC. The second function includes studying the effect of weeds that emerge in more advanced stages of the crop's growth period and allows us to know the end of the CPC (Lacerda *et al*., 2020).

Cerna and León (2015) found in irrigated cowpeas that CPC occurs between 21-42 days after emergence (DAE) in Peru, while Castro *et al*. (2019) and Campos *et al*. (2023) reported a CPC of 9 and 41 DAE for northeastern Brazil, and between 11 and 36 DAE in the semi-arid region of Brazil.

No CPC are determined for the humid Caribbean subregion of Colombia; therefore, the objective of the research was to determine the critical period of competition in the cultivation of cowpea beans for that region.

MATERIALS AND METHODS

Biological material and experimental area

The Missouri variety with an erect growth habit was used. The research was carried out on farmers' fields, in the municipality of Cereté-Colombia, during the end of the rainy season of the second half of 2022 (October 27 to December 27, 2022: dry season) and during the beginning of the rainy season of the first half of 2023 (April 24 to June 24, 2023: rainy season). The town is located between the Geographic coordinates (8°57'24.7" N and 75°45'10.3" W), altitude of 12 m a.s.l., average annual precipitation of 1,300 mm, average temperature of 28°C and 6-7 h average sunshine. In 2022B, during the crop cycle, a rainfall of 147 mm was recorded, while in 2023A, it was 327 mm. The soil analysis showed the following: texture: silty-clay; pH=5.6; OM=2.32%; S=1.1 mg kg^{-1}; P=7.9 mg kg^{-1}; Ca=14.68 $cmol_{(+)}$ kg^{-1}; Mg=7.31 $cmol_{(+)}$ kg^{-1}; K=0.61 $cmol_{(+)}$ kg^{-1}; CEC=22.7 $cmol_{(+)}$ kg^{-1}. The soil was prepared conventionally, with plowing and harrowing.

Experimental design

A randomized complete block design was used, with eight treatments and four replications. The treatments consisted of four-time intervals of weeds control (WC): 0-10, 0-20, 0-30 and 0-50 days after the emergency (DAE) and the same time intervals for coexistence (Co) of the crop with weeds (0-10, 0-20, 0-30 and 0-50 DAE). A total of 32 experimental units, consisted of 4 rows 5 m long, with spacing between rows and between plants of 0.40 and 0.25 cm, respectively, and a planting density of 100.000 sites/ha, 2 seeds were sown per site and the useful plot was made up of the two central rows. The CPC was evaluated with the variable grain yield (YIELD) for all treatments. Dry mass of weeds (DMW) and percentage of cover (COV) were evaluated in three seasons of coexistence of the crop with weeds: 0-10, 0-20 and 0-30 DAE with readings on a grid of 0.25 × 0.25 m, in each experimental unit. The composition of the weed community was recorded, according to the taxonomic classification, and the density of weeds per m^2 (DW); and the index of occurrence (IO) was calculated as the percentage per species concerning the total found.

Analysis of data

For the yield variable, analysis of variance was carried out by semester and combined, orthogonal contrasts and linear, quadratic, exponential, logarithmic, potential and non-linear (logistic) regression methodologies. The orthogonal contrasts tested and estimated were: C1: weeds control *vs*. coexistence with weeds; C2: control 10, 20 and 30 DAE *vs*. control 50 DAE; C3: control 10 and 20 DAE *vs*. control 30 DAE; C4: control 10 DAE *vs*. control 20 DAE; C5: coexistence 10, 20, 30 DAE *vs*. coexistence 50 DAE; C6: coexistence 10 and 20 DAE *vs*. coexistence 30 DAE; C7: coexistence 10 DAE *vs*. coexistence 20 DAE. For the DMW and COV variables, analysis of variance and Tukey's multiple comparisons at 5%. Compliance with the assumptions of normality, homogeneity of variances and additivity was verified for the individual and combined analyzes of variances. The regression models were evaluated according to the criteria:

Anova, coefficients of determination, residual analysis and significance of the predictors. Simple linear, polynomial, exponential, logarithmic, potential and logistic regression models were adjusted, and those with the best fit were selected for the estimation of the CPC, estimating a 5% loss in relation to the maximum yield estimated with the regression models. For the DMW and COV variables, analysis of variance and Tukey's multiple comparisons at 5%. And SAS software version 9.0 (2002) was used.

RESULTS AND DISCUSSION

Grain yield in the dry season

The contrast of the YIELD between 0-10, 0-20 and 0-30 DAE, as a whole, and 0-50 DAE of weed control, was significant (P=0.0005), in favor of 0-50 DAE, i.e., the maintenance of weed-free cultivation (Tab. 1). This could be costly, for 50 d represent 83.3% of the crop cycle which, for the conditions of the humid Caribbean region of Colombia, is approximately 60 d. However, weeds control in the interval of 0-30 DAE was better compared to the intervals of 0-10 and 0-20 DAE, as a whole. This indicates that, under the conditions of the dry season of the year and 147 mm of precipitation during the cycle, the strategy of keeping the crop free of weeds during the first 30 d is the best. Similar results were reported by Campos *et al.* (2023), but differ from Cerna and León (2015) and Castro *et al*. (2019), mainly due to the environmental conditions prevailing when the evaluations were carried out, as well as the duration of the cycle of the cultivar used.

The highest YIELD, 2,547.5 kg ha^{-1}, was obtained by keeping the crop weed-free from emergence to 50 DAE, while the lowest YIELD, 887.5 kg ha^{-1}, was achieved by controlling weeds during the first 10 DAE. Therefore, the decrease in YIELD due to weed competition, with the control strategy for 50 DAE, was 65.2%, lower those that shown by Campos *et al*. (2023) of 90% and higher than the results obtained by Castro *et al.* (2019) of 39.8% in the semi-erect genotype and 37.27% in the semi-prostrate genotype of cowpea beans, differences were supported by the edaphoclimatic conditions, weed community and cultivar genetics.

According to the coexistence of crop-weeds, when contrasting the intervals 0-10, 0-20 and 0-30 DAE, as a whole, and the interval of 0-50 DAE there was significant difference ($P\leq$0.0001) in favor of the first three intervals (0-10, 0-20 and 0-30 DAE), doubling the yield with respect to the presence of weeds for 50 d (Tab. 1). Likewise, no significant differences were found (P=0.8496 and P=0.6513, respectively) between the interval of 0-30 DAE and those of 0-10 and 0-20 DAE as a whole, nor when comparing the intervals of 0-10 and 0-20. This suggests that, under the conditions of the dry season, the strategy of sowing and maintaining the crop in coexistence with weeds could be viable up to 30 DAE, which would represent a decrease in production costs, flowering without problems and a greater number of pods per plant (Castro *et al*., 2019).

With the YIELD for each time interval and the two weed management strategies, the best-fit equations were estimated and selected, which were linear for

Table 1. Orthogonal contrasts corresponding to grain yield (kg ha^{-1}) of the cowpea cultivar Missouri, in the dry season of semester B of 2022.

Contrast	Mean squares	Estimator	Treatments	Means
			Control 0-10 DAE	887.5 c
C1	0.0882^{ns}	-0.420	Control 0-20 DAE	1,445.0 bc
C2	2.576**	-2.780	Control 0-30 DAE	2,530.0 a
C3	4.960**	-2.728	Control 0-50 DAE	2,547.5 a
C4	0.622^{ns}	-0.558	Coexistence 0-10 DAE	2,322.5 ab
C5	3.922**	3.430	Coexistence 0-20 DAE	2,195.0 ab
C6	0.006^{ns}	0.006	Coexistence 0-30 DAE	2,212.5 ab
C7	0.033^{ns}	0.128	Coexistence 0-50 DAE	1,100.0 c

C1: weeds control *vs*. coexistence with weeds; C2: control 10, 20 and 30 DAE *vs*. control 50 DAE; C3: control 10 and 20 DAE *vs*. control 30 DAE; C4: control 10 DAE *vs*. control 20 DAE; C5: coexistence 10, 20, 30 DAE *vs*. coexistence 50 DAE; C6: coexistence 10 and 20 DAE *vs*. coexistence 30 DAE; C7: coexistence 10 DAE *vs*. coexistence 20 DAE.

coexistence and potential for control (Fig. 1). These models show the variation of grain yield as a function of the DAE. By estimating 5% losses in relation to the maximum grain yield estimated with the models, the CPC was 14 to 33 DAE. For this species, Lacerda *et al*. (2020) and Campos *et al.* (2023) in Brazil, have reported CPC of 21 to 32 DAE, while Osipitan (2017), places it within the first 40 DAE. Despite being the same species, these differences in terms of the location of the CPC in the cowpea life cycle can be attributed to the climatic conditions of each place, the genetics of the cultivar and the fact that the competition of weeds are closely related to the seed bank of each soil.

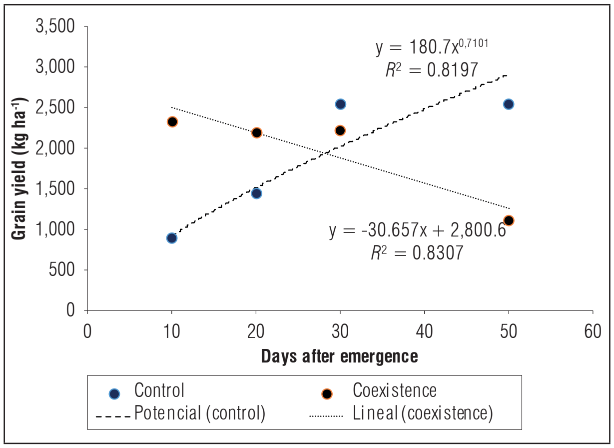

Figure 1. Functional relationship between cowpea yield and weed control intervals and coexistence with the crop, end of the dry season of semester B of 2022.

Grain yield in the rainy season

The contrast of the YIELD between 0-10 and 0-20 DAE, as a whole, and 0-30 DAE, was significant (P=0.0154), in favor of 0-30 DAE, i.e., keeping the crop free of weeds for 30 DAE (Tab. 2). This difference was further evidenced by the non-significance (P=0.5348) of the contrast between the weed control in 0-10 and 0-20 DAE. This indicates that, under the conditions of the rainy season of the year, the strategy of keeping the crop free of weeds during the first 30 DAE, leads to a higher YIELD compared to the first 10 or 20 DAE.

The highest YIELD, 553.5 kg ha^{-1}, was obtained by keeping the crop weed-free, from emergence to 50 DAE, while the lowest YIELD, 316.9 kg ha^{-1}, was achieved by only controlling weeds during the first 10 DAE. Consequently, the decrease in the YIELD due to the interference of weeds with the control strategy for 50 DAE was 42.75%, possibly due to competition for light and nutrients, increased presence of pests and diseases, and allelopathic effects caused by fungi and weeds that affect grain production and quality, since the exudates affect the growth of the radicle, size and vigor of the cowpea seedling (Lacerda *et al*., 2020; Al-Deliamy and Abdul-Ameer, 2023).

According to the coexistence strategy, the contrast between the treatments 0-10, 0-20 and 0-30 DAE, as a whole, and 0-50 DAE was significant ($P \leq 0.0004$), in favor of the first three treatments (Tab. 2). This result is complemented by the significance (P=0.0095)

Table 2. Orthogonal contrasts corresponding to grain yield (kg ha^{-1}) of the cowpea cultivar Missouri, in the rainy season of semester A of 2023.

Contrast	Mean squares	Estimator	Treatments	Mean
			Control 0-10 DAE	316.8 ab
C1	0.029^{ns}	0.2408	Control 0-20 DAE	385.0 ab
C2	0.043^{ns}	-0.3608	Control 0-30 DAE	598.0 a
C3	0.163*	-0.4943	Control 0-50 DAE	553.5 a
C4	0.009^{ns}	-0.0683	Coexistence 0-10 DAE	631.5 a
C5	0.417**	1.1185	Coexistence 0-20 DAE	539.5 a
C6	0.191**	0.5350	Coexistence 0-30 DAE	318.0 ab
C7	0.017^{ns}	0.0920	Coexistence 0-50 DAE	123.5 c

C1: weeds control *vs*. coexistence with weeds; C2: control 10, 20 and 30 DAE *vs*. control 50 DAE; C3: control 10 and 20 DAE *vs*. control 30 DAE; C4: control 10 DAE *vs*. control 20 DAE; C5: coexistence 10, 20, 30 DAE *vs*. coexistence 50 DAE; C6: coexistence 10 and 20 DAE *vs*. coexistence 30 DAE; C7: coexistence 10 DAE *vs*. coexistence 20 DAE. DAE, days after emergence.

of the contrast between the treatment 0-30 DAE and the treatments 0-10 and 0-20 DAE, taken together, in favor of coexistence during the first 10 or 20 DAE. This suggests that, under the conditions of the rainy season of the year, the strategy of maintaining the crop in coexistence with the weeds was effective until 20 DAE.

The decrease in YIELD due to the competition of weeds with the coexistence strategy was 80.46%, higher than the achieved with the control strategy. Similar results have been shown by Lacerda *et al*. (2020), with a decrease in cowpea yield by 73.5% when grown with weeds throughout its cycle, under semi-arid conditions, in Brazil. Likewise, Osipitan (2017) reported a 76% decrease due to weeds in Africa.

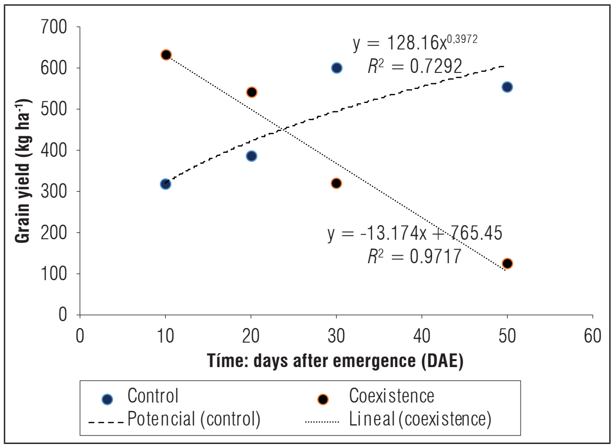

Figure 2. Functional relationship between cowpea yield and weed control intervals and coexistence with cultivation, end of the rainy season, 2023A.

With the YIELD for each time interval in both weed management strategies, the best-fit equations were estimated and selected (Fig. 2). These models show the variation of grain yield as a function of the days after emergence. By estimating 5% losses in relation to the maximum grain yield estimated with the models, the CPC was 14 to 29 DAE.

The combined analysis of variance of the YIELD obtained in the two seasons, dry and rainy, shows significant differences for season of the year ($P \leq 0.0001$), between treatments ($P=0.0235$) and in the season-treatments interaction ($P=0.0386$). This interaction shows that the yield varies according to the season of the year, with a better performance in the dry season, since the aggressiveness of the weeds is reduced by less water availability in the soil. In both seasons, the weed control strategy resulted in higher yields at 30 and 50 DAE, while with the coexistence strategy, it was at 10 and 20 DAE (Fig. 3).

Composition of the weed community

During the two experimental seasons, and cumulatively, 18 species of weeds belonging to 11 families were recorded. Table 3 shows the taxonomic classification, the number of individuals, the IO and the DW (species with at least 10 individuals/m^2). Weeds of the Liliopsidae class predominated with 73%, over the Magnoliopsida class with 27%. In this sense,

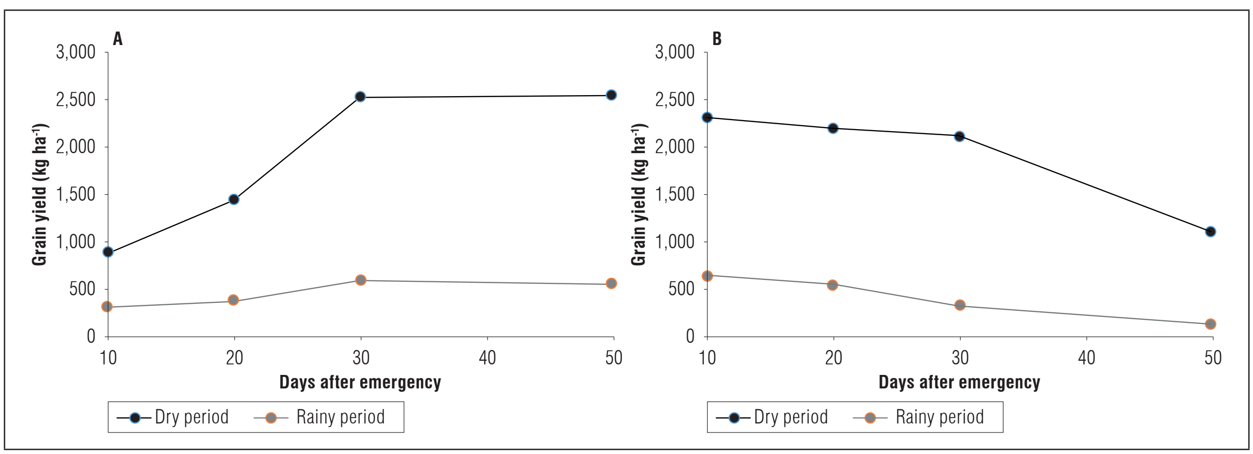

Figure 3. Season-treatment interaction for cowpea bean yield and weed control intervals (A) and coexistence (B), dry season 2022B and rainy season 2023A.

Lacerda *et al.* (2020), obtained similar results when evaluating the CPC of weeds with cowpea beans, where weeds of the botanical class Liliopsida and family Poaceae predominated, this behavior is attributable to environmental conditions with high temperatures and intense solar radiation, conditions that are also present around this research.

The specie *Rottboellia cochinchinensis*, the one with the highest IO and DW, has a recognized competitive capacity in various crops (Castro *et al*., 2019), including cowpea beans. Likewise, Peerzada *et al.* (2016) and Shabbir *et al*. (2019) agreed in stating that *Echinochloa colona* is a weed responsible for yield losses of up to 50% in crops, its success is attributed to its prolific seed production, rapid growth, allelopathic power and adaptability to a wide range of environments, which leads to decreased number of pods, grain mass and yield in cowpea (Maia *et al*., 2021).

Additionally, de la Cruz-Zapata *et al*. (2016) reported *Urochloa fusca* as a host of *Aeneolamia contigua* and *Prosapia simulans*, considered insect pests in several crops the weed species is very efficient in the accumulation of nutrients and their level of interference depends on the weed community present (Marques *et al*., 2019). Furthermore, *Euphorbia heterophylla* has been reported to be more efficient than soybean in the use of nitrogen absorbed from the soil (Silva *et al*., 2015).

The above explains why inadequate management of weeds negatively influences the chlorophyll content, pod production and protein content in the grain (Coelho *et al*., 2019).

Dry mass of weeds and cover (%)

The analysis of variance showed significant differences between the two study seasons (P=0.0024), as well as between treatments (P=0.0066) for DMW (Tab. 4). The difference between seasons can be attributed to the frequency and intensity of rainfall, given that the first experiment was set in the dry season of 2022, and the 147 mm of rainfall during the crop cycle, whereas in the rainy season of 2023, rainfall of 327 mm during the cycle was frequent and intense. Similar results were reported by Yadav *et al.* (2017) in cowpeas, in India, and highlighted that the weed problem is more serious during the rainy season, since weeds grow very quickly, compete for light, nutrients and space, causing a reduction in yield.

The treatment with the highest DMW, in both seasons, was coexistence during the first 30 DAE (Tab. 4), due to the longer time for the growth and development of the weeds due to the possible allelopathic effect they exert on the bean, which associated with their slow growth affects the final yield and this shows the need for efficient weed control in the first days. Similar results were found by Grazziero *et al*. (2019), who reported that as the dry mass of weeds increases, it shows a linear reduction in grain yield, thus 200 g m^{-2} of DMW caused a reduction between 223 and 722 kg ha^{-1} in soybeans.

Table 3. List of weeds with at least 10 individuals per m², in two cultivation cycles of the Missouri cowpea cultivar.

Scientific name	CN	Class	Family	IO	DW
Rottboellia cochinchinensis	Caminadora	Liliopsidae	Poaceae	30.3	90
Echinochloa colona	Liendre puerco	Liliopsidae	Poaceae	13.3	39
Urochloa fusca	Granadilla	Liliopsidae	Poaceae	10.6	31
Desmodium tortuosum	Pegapega	Magnoliopsidae	Fabaceae	6.7	20
Euphorbia heterophylla	Lecherita	Magnoliopsidae	Euphorbiaceae	5.6	17
Eclipta prostrata	Botón blanco	Magnoliopsidae	Asteraceae	5.4	16
Cynodon dactylon	Pasto bermuda	Liliopsidae	Poaceae	5.2	15
Commelina difusa	Suelda con suelda	Liliopsidae	Commelinaceae	4.9	15
Caperonia palustris	Caperonia	Magnoliopsidae	Euphorbiaceae	3.4	10

CN: common name in Spanish; IO: index of occurrence (%); DW: density of weeds/m².

Table 4. Analysis of variance and comparisons of means for dry mass (DMW) and percentage of cover (COV) of the weeds in the two seasons (2022B and 2023A) of the Missouri cultivar cowpea crop.

Dry mass of weeds			
SV	CM	Season	Mean
Season	494.09*	Dry 2022B	2.777 b
Block (Season)	56.65	Rainy 2023A	11.852 a
Treatment	265.61**	**Treatment**	**Mean**
Season x treatment	37.97^{ns}	Coexistence 10 DAE	2.695 b
Error	33.85	Coexistence 20 DAE	5.477 b
Mean	7.31	Coexistence 30 DAE	13.771 a
CV (%)	79.55		
Weed coverage			
FV	COV	Season	Mean
Season	1190.04^{ns}	Dry 2022B	35.25 a
Block (Season)	311.82	Rainy 2023A	49.33 a
Treatment	3,222.04**	**Treatment**	**Mean**
Season x treatment	2,406.54**	Coexistence 10 DAE	23.25 b
Error	234.57	Coexistence 20 DAE	40.37 b
Mean	42.29	Coexistence 30 DAE	63.25 a
CV (%)	36.21		

Coexistence 10, 20, 30 DAE = Coexistence of cowpea with weeds for 10, 20 and 30 days after emergence.

CONCLUSION

The critical period of weed competition in the cultivation of cowpea beans (*Vigna unguiculata* (L.) Walp.), Missouri cultivar, for the dry and rainy seasons was 14-33 and 14-29 days after emergence, respectively.

The species *Rottboellia cochinchinensis*, *Echinochloa colona* and *Urochloa fusca*, showed an occurrence rate between 10.6 and 30.3% and a higher density (31 to 90 m^2), in dry and rainy seasons together.

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