http://journal.unoeste.br/index.php/ca/index
DOI: 10.5747/ca.2022.v18.n3.a497
ISSN on-line 1809-8215

Colloquium Agrariae

Submetido: 27/05/2021 Revisado: 01/08/2022 Aceito: 24/10/2022

Weed interference in caupi beans (*Vigna unguiculata*) grown in Januária, north of Minas Gerais, Brazil

Deyvisson Rodrigues Pinto[1], Claubert Wagner Guimarães de Menezes[1], Edson Aparecido dos Santos[2], Matheus Ferreira França Teixeira[3], Carlos Henrique Batista[1]

[1]Instituto Federal do Norte de Minas Gerais – IFNMG, MG. [2]Universidade Federal de Uberlândia – UFU, MG. [3]Universidade Federal de Viçosa – UFV, MG. E-mail: claubertmenezes@yahoo.com.br

Abstract

The degree of weed interference in an agricultural crop is influenced by edaphoclimatic characteristics, the management used in the environment and the period of coexistence between the weeds and the crop of interest. This study aimed to determine periods of weed interference in cowpea (*Vigna unguiculata* - Fabaceae) var. BRS Potengi in the semiarid of northern Minas Gerais, Brazil. Treatments consisted of periods of control and coexistence of cowpea with weeds under irrigated cultivation (0, 7, 14, 21, 28, 35, 42, 49, 56, 63, and 77 days after crop emergence). At the end of each period of coexistence and harvest time, weeds were quantified and identified, and dry matter was determined. Stem diameter, number of pods per plant, and grain yield were obtained for cowpea. The main weeds found were *Cenchrus echinatus*, *Panicum maximum*, *Eleusine indica* (Poaceae), and *Amaranthus retroflexus* (Amaranthaceae). The period before interference (PBI) occurred up to 9 days after emergence, the total period of interference prevention (TPIP) occurred up to 23 days after emergence, and critical period of interference prevention (CPIP) was observed between 9 and 23 days after emergence. Weed interference during the entire cowpea cycle reduced yield by 37% when compared to the control treatment.

Keywords: competition; control; semi-arid; yield.

Interferência de plantas daninhas em feijão-caupi (*Vigna unguiculata*) cultivado em Januária, norte de Minas Gerais, Brasil

Resumo

O grau de interferência de plantas daninhas em uma cultura agrícola é influenciado pelas características edafoclimáticas, pelo manejo utilizado no ambiente e pelo período de convivência entre as plantas daninhas e a cultura de interesse. Este trabalho teve como objetivo determinar períodos de interferência de plantas daninhas em feijão-caupi (*Vigna unguiculata* - Fabaceae) var. BRS Potengi no semiárido do norte de Minas Gerais, Brasil. Os tratamentos consistiram em períodos de controle e convivência do feijão-caupi com plantas daninhas sob cultivo irrigado (0, 7, 14, 21, 28, 35, 42, 49, 56, 63 e 77 dias após a emergência da cultura). Ao final de cada período de convivência e época de colheita, as plantas daninhas foram quantificadas e identificadas, e a matéria seca foi determinada. O diâmetro do caule, número de vagens por planta e produtividade de grãos foram obtidos para o feijão-caupi. As principais plantas daninhas encontradas foram *Cenchrus echinatus*, *Panicum maximum*, *Eleusine indica* (Poaceae) e *Amaranthus retroflexus* (Amaranthaceae). O Período Anterior à Interferência (PAI) ocorreu até 9 dias após a emergência, o Período Total de Prevenção à interferência (PTPI) ocorreu até 23 dias após a emergência e o Período Crítico de Prevenção à Interferência (PCPI) foi observado entre 9 e 23 dias após a emergência. A interferência de plantas daninhas durante todo o ciclo do feijão-caupi reduziu a produtividade em 37% quando comparado ao tratamento controle.

Palavras-chave: competição; controle; rendimento; semi-árido.

Introduction

Cowpea (*Vigna unguiculata* - Fabaceae) adapts to conditions of water deficit, high temperatures, and luminosity, which are common in semiarid regions. This species has high protein content (24.5%), carbohydrates (51.4%), and dietary fibers (19.4%) in its grains (FROTA *et al.*, 2008), being the food of interest for Brazil. Cowpea cultivation is an alternative for Brazilian family farming at different technological levels (BATISTA *et al.*, 2017). Its cultivation is common in the North and Northeast regions of Brazil, but it has been expanded to the Midwest in recent years (BEZERRA *et al.*, 2012), with a mean yield of 1,200 kg ha^{-1}. However, the mean national production of cowpea was 534 kg ha^{-1} in the 2021 season (CONAB, 2022).

Cowpea cultivation is traditional in northern Minas Gerais and adapts to the semiarid climate of the region, which has an irregular precipitation distribution, high temperatures, and low air humidity (BATISTA *et al.*, 2017). However, cowpea yield is low in northern Minas Gerais due to the applied technology level, use of low yielding cultivars, and lack of weed management strategies (GUERRA *et al.*, 2017, LACERDA *et al.*, 2021).

Weeds may cause losses to crops due to competition for nutrients, water, and solar radiation (SILVA; LIMA, 2012), leading to quantitative (yield) and qualitative losses (dietary fiber) to cowpea. Also, weeds may increase operational costs of harvesting, drying, and processing of cowpea (MEDEIROS *et al.*, 2021).

The period before interference (PB) is considered that in which the crop can remain in the presence of weeds without significant yield losses, while the total period of interference prevention (TPIP) is the one in which the crop must remain free from the presence of weeds, so that its yield is not negatively affected, and the critical period of interference prevention (CPIP) is the period in which interference losses are intense, being weed control mandatory (PITELLI; DURIGAN, 1984). In addition to the periods of interference in crop yield, the period prior to economic loss (PPEL) complements the other periods of interference since it is a methodology proposed with the aim at defining the time of weed control taking into account their cost of control to define the acceptable value of production losses (VIDAL *et al.*, 2005).

Studies on weed interference in cowpea are scarce in northern Minas Gerais, hampering and burdening the control costs to farmers. Thus, determining the periods of weed interference in cowpea is a way to optimize decision-making on the time and control method, making the agricultural activity profitable and sustainable to the producer. This study aimed to determine periods of weed interference in cowpea and evaluate their effects on crop yield under the agricultural conditions of Januária, northern Minas Gerais, Brazil.

Material And Methods

The experiment was conducted between May and August 2016, in (blinded review), northern Minas Gerais (MG), Brazil. The predominant regional climate is Aw, i.e., a humid tropical climate with a dry winter and rainy summer according to the international Köppen classification (KOTTEK *et al*., 2006). The local soil is classified as a sandy loam textured Quartzarenic Neosol (Table 1).

Table 1. Soil analysis of the experimental area at a depth of 0-20 cm

pH (H_2O)	OM (dag kg^{-1})	P (mg dm^{-3})	K	Ca	Mg ($comol_c$ dm^{-3})	H+Al	Sand	Silt (dag kg^{-1})	Clay
6.45	0.6	51.6	63	4.3	0.6	1.49	75	7	18

The area was used for planting pasture for more than ten years, for sheep farming. The forage grasses were renewed in a conventional planting system, with plowing, harrowing and leveling. In the last three years, grain cultivation began. There is no record of a weed management program and a soil seed bank in the area.

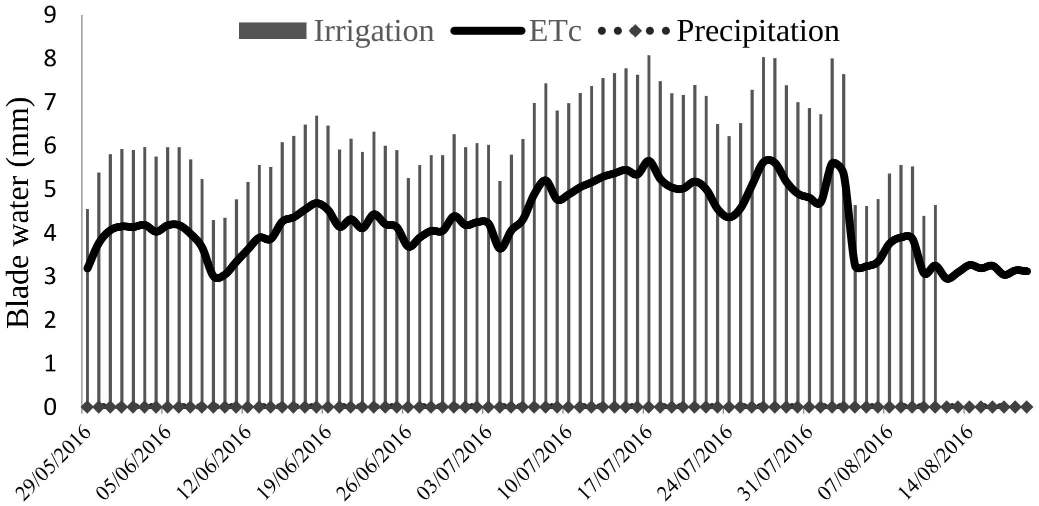
A plowing and two harrowing operations were carried out as soil tillage, according to the conventional cultivation system. Planting fertilization was conducted based on soil analysis (Table 1) and crop recommendations (ANDRADE JÚNIOR *et al.*, 2002), using 20 kg ha^{-1} of P_2O_5, 20 kg ha^{-1} of K_2O, and 20 kg ha^{-1} of N in the form of simple superphosphate, potassium chloride, and urea, respectively.

The experimental design was a randomized block design with 20 treatments and four replications. Treatments were divided into two evaluation groups, i.e., the periods of control and coexistence of the crop with weed population in the area. The crop remained in the absence of weeds in the control group due to manual weeding carried from its emergence to the end of a certain period, as follows: 0, 0-7, 0-14, 0-21, 0-28, 0-35, 0-42, 0-56, 0-63, and 0-77 days after cowpea emergence (DAE). At the end of these periods, weeds that emerged grew freely, without being weeded. Plots of the second group of coexistence remained in the presence of weeds during the same periods described for the first group, being controlled by manual weeding at the end of the period.

The experimental plot was composed of four 5 m long rows spaced at 0.5 m from each other, totaling 7.5 m^2. The useful area of the experiment was considered to be the two central rows of each plot without 0.50 m from the end of each row in order to remove the border effect. Sowing was carried out manually with two seeds every 12 cm, totaling a population of 166,667 plants ha^{-1} after manual thinning, with a cowpea plant of the cultivar BRS Potengi per pit.

The experiment was conducted under sprinkler irrigation with water application defined by the complete replacement of the crop evapotranspiration (Figure 1). The applied water depth and reference evapotranspiration were estimated by the Hargreaves and Samani equation, and Kc was recommended by EMBRAPA (BASTOS *et al.*, 2008). The climatological data of the experimental period were obtained at the INMET meteorological station located at (blinded review), Instituto Federal do Norte de Minas Gerais (MG), *Campus* Januária, Brazil.

Figure 1. Water depth applied by irrigation according to the evapotranspiration of cowpea cv. BRS Potengi (*Vigna unguiculata* - Fabaceae), winter crop, Januária – MG, 2016.



Weed influence on cowpea for each period of coexistence was determined by evaluating the following crop yield components: stem diameter (mm), number of pods per plant, number of grains per pod, one thousand-grain weight (g), and yield (kg ha^{-1}) (BRASIL, 2009). Harvesting was performed 77 DAE.

At the end of each period of coexistence and harvest, for the initially controlled periods, evaluations were carried by randomly placing a 0.5 × 0.5 m (0.25 m^2) square on the useful area of each plot (FREITAS *et al.*, 2009). Plants were cut close to the soil, collected, quantified, and separated by botanical family and species (LORENZI, 2014). After weed identification, the material was placed in a drying oven at 65 °C for 72 hours until reaching constant weight to obtain the dry matter.

The results obtained for each species and sampling point were used to calculate the relative frequency and density proposed by Pitelli and cited in Alves e Lopes (2014), where the relative frequency is the frequency of species divided by the sum of the frequency of all species and density is the number of individuals found per sampled unit area.

Regression curves were adjusted for the mean data of stem diameter, number of pods per plant, number of grains per pod, and one thousand-grain weight (g) of cowpea and dry matter of weeds.

Plant height, final stand, number of pods per plant, yield, and one thousand-grain weight were evaluated separately within each group (initial periods of coexistence or weed control). The results were submitted to analysis of variance ($p<0.05$). Weed interference periods (control and coexistence) were analyzed by the Boltzmann sigmoidal regression model (KUVA *et al.*, 2000), which determines the critical period of interference prevention (CPIP). This model is expressed by the logistic equation $y = y_0 + a/\ (1 + (x/x_0)$, where y is the maximum crop yield, y_0 is the minimum yield found at plots where crop coexisted with weeds throughout the period, a is the difference between the maximum and minimum yields at plots maintained free from weeds during the entire period, x is the days after emergence, x_0 is the number of days when there was a 50% reduction in maximum yield, and b is the curve slope.

The limits of periods of interference were determined by tolerating maximum losses of grain yield to a 5% level in relation to the treatment maintained free from weeds throughout the cycle. Treatments maintained free from weeds and under weed coexistence during the entire experimental period (0-77 days) were used in the composition of the two curves, which determine PBI and TPIP. The data were analyzed using the statistical program R (R DEVELOPMENT CORE TEAM, 2016).

The methodology proposed by Vidal *et al.* (2005) was used to determine PPEL with the equation PPEL = (HP + AC)/ (PL × CY), where HP is the herbicide price, AC is the herbicide application cost, PL is the daily percentage loss, and CY is the crop yield. Herbicides that have selectivity to cowpea were used to calculate the simulation since there are no herbicides registered to this crop (MESQUITA *et al.*, 2017). Fluazifop and imazethapyr were used to control Poaceae (narrow leaves) and eudicotyledonous species (broad leaves) in post-emergence, respectively. The herbicide price was R$ 12.00 ha^{-1}, while application cost was R$ 22.73 ha^{-1} (MARCONDES, 2017). The daily percentage loss was obtained using a linear regression between crop yield and the initial days of coexistence (up to 35 DAE) between weeds and crop, with PL = 0.0053. Crop yield was considered as the yield of the control (1,200 kg ha^{-1}).

Results and Discussion

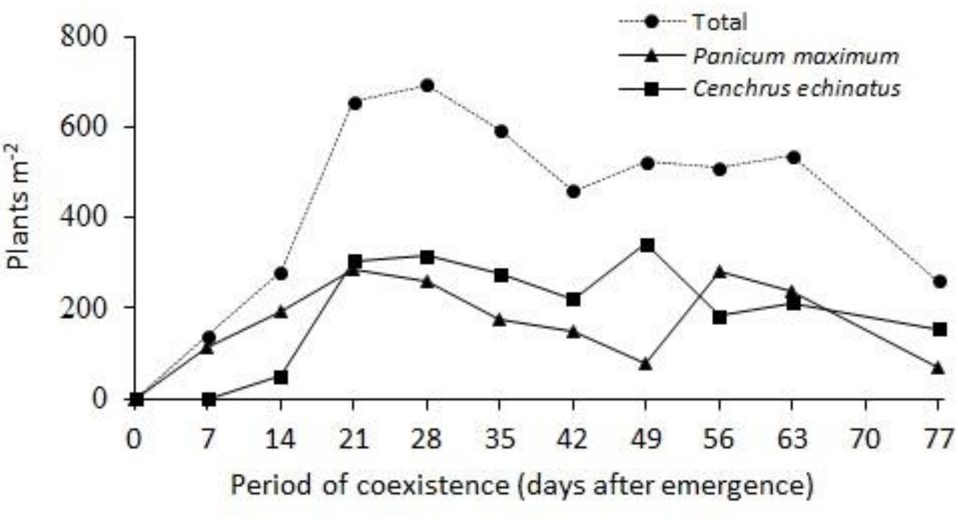
Twenty-two weed species were identified, 73% of them classified as dicotyledonous and 27% monocotyledonous. The botanical families Amaranthaceae and Poaceae stood out, with 22 and 18% of the species, respectively (Table 2). The species *Cenchrus echinatus* (Poaceae) was the most common weed in the area (23.6%), followed by *Panicum maximum* (Poaceae), *Eleusine indica* (Poaceae), and *Amaranthus retroflexus* (Amaranthaceae), with frequencies of 14.6, 11.2, and 10.3%, respectively. The highest infestation of *C. echinatus* was observed at 49 days after cowpea emergence (DAE), with 342 plants m^{-2}. The highest density of *P. maximum* was observed at 21 DAE, with 285 plants m^{-2}. In the harvest period of cowpea, the infestation of *C. echinatus* and *P. maximum* was reduced by 55.3 and 75.8%, respectively, due to plant senescence and the suppression caused by the crop (Figure 2).

Table 2. Weeds found in cowpea cultivation, cultivar BRS Potengi, winter crop, Januária-MG, 2016

Family	Scientific name	Common name	Code	Rf (%)
Poaceae	*Cenchrus echinatus*	Southern sandbur	CCHEC	23.6
Poaceae	*Panicum maximum*	Guineagrass	PANMA	14.6
Poaceae	*Eleusine indica*	Goosegrass	ELEIN	11.2
Amaranthaceae	*Amaranthus retroflexus*	Redroot pigweed	AMARE	10.3
Portulacaceae	*Portulaca oleracea*	Common purslane	POROL	9.0
Convolvulaceae	*Merremia cissoides*	Roadside woodrose	MRRCI	5.6
Amaranthaceae	*Amaranthus deflexus*	Low amaranth	AMADE	3.9
Amaranthaceae	*Amaranthus viridis*	Slender amaranth	AMAVI	3.9
Asteraceae	*Bidens pilosa*	Hairy beggarticks	BIDPI	3.4
Amaranthaceae	*Alternanthera tenella*	Calicoplant	ALRTE	2.6
Fabaceae	*Aeschynomene rudis*	Rough jointgrass	AESSH	1.7
Convolvulaceae	*Ipomoea purpurea*	Tall morningglory	PHBPU	1.7
Asteraceae	*Conyza bonariensis*	Hairy fleabane	ERIBO	1.3
Poaceae	*Cynodon dactylon*	Bermudagrass	CYNDA	1.3
Convolvulaceae	*Ipomoea triloba*	Threelobe morningglory	IPOTR	1.3
Fabaceae	*Senna obtusifolia*	Sicklepod	CASOB	1.3
Fabaceae	*Desmodium tortuosum*	Florida beggarweed	DEDTO	0.9
Euphorbiaceae	*Euphorbia heterophylla*	Wild poinsettia	EPHHL	0.9
Commelinaceae	*Commelina benghalensis*	Benghal dayflower	COMBE	0.4
Asteraceae	*Praxelis pauciflora*	Praxelis	EUPPF	0.4
Poaceae	*Urochloa plantaginea*	Alexandergrass	BRAPL	0.4
Malvaceae	*Waltheria americana*	Uhaloa	WALAM	0.4

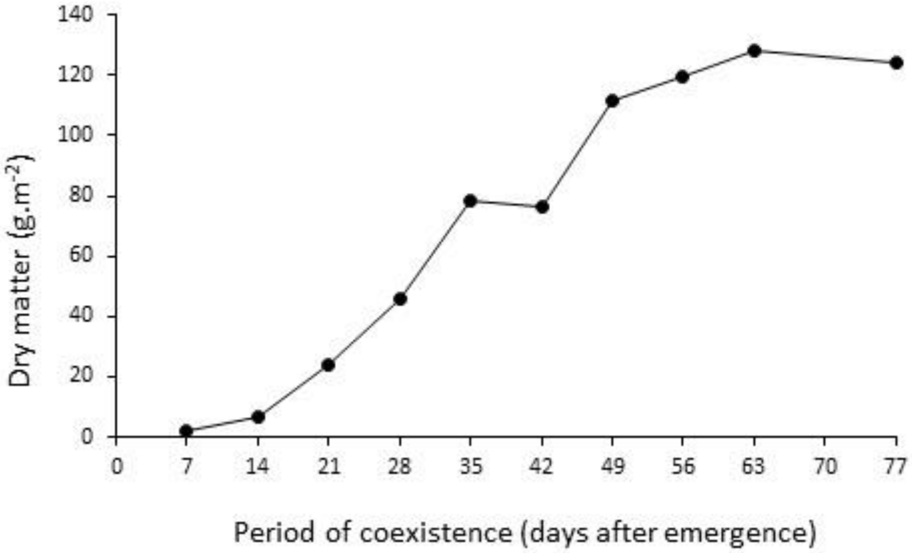
Rf (%) = Relative frequency (%)

Figure 2. Total density of the main weed species (*Cenchrus echinatus* - CCHEC and *Panicum maximum* - PANMA) in the weed community during the periods of coexistence with cowpea cv. BRS Potengi, winter crop, Januária-MG, 2016.



The highest weed density was observed at 28 DAE, with 693 plants m^{-2}. A 37.5% reduction in weed density was observed from 28 DAE to harvest (Figure 2). On the other hand, the total shoot dry matter accumulation of weeds increased up to 63 DAE, with 128 g m^{-2}, followed by a 3% decrease at 77 DAE (Figure 3).

Figure 3: Total shoot dry matter of weeds in the weed community during the periods of coexistence with cowpea cv. BRS Potengi, winter crop, Januária-MG, 2016.



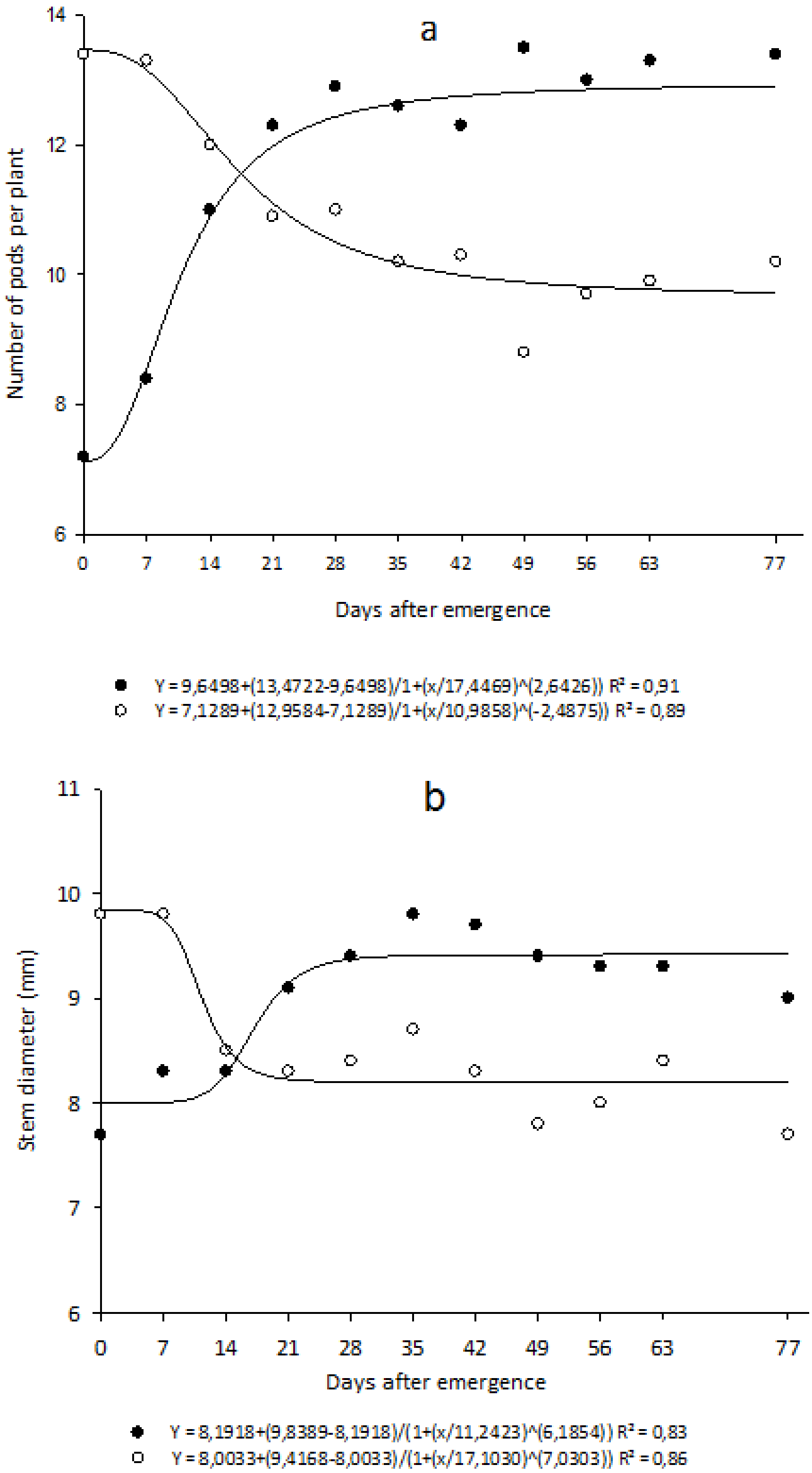
The development of the cowpea shoots after 28 DAE caused a restriction in the passage of light and hence affected weed growth and establishment. This behavior was observed in cowpea cv. BRS Guariba (FONTES *et al.*, 2013) and soybean (*Glycine max* - Fabaceae) (NORSWORTHY, 2004), in which canopy development influenced the light quality and emergence of some weeds, allowing the crop to stand out. In addition to crop competition, inter- and intraspecific competitions occur in weed community, in which individuals with higher competitive ability tend to dominate others, especially in situations with very high initial populations, where there is no physical space for the establishment of all individuals (PAULO *et al.*, 2001).

The reduction of the total dry matter accumulation in the weed community from 77 DAE (Figure 3) occurred due to the beginning of senescence of some species. However, the increase in the total dry matter was almost constant despite the reduction in weed density (Figure 2). The high frequency of *P. maximum* (14.6%) may have contributed to an increase in the dry matter since it is a large plant with a fast-dry matter accumulation (SILVA *et al.*, 2014). Plants with C4 metabolism adapt well to regions with a hot and dry climate, and to semi-arid regions, compared to plants with C3 metabolism. In this way, they are favored in the competition for nutrients, water and solar radiation, standing out in the cultivation area (LACERDA *et al.*, 2021).

On the other hand, the area's management history may contribute to the incidence of higher or lower frequency of specific weed botanical families. The type of soil preparation, the non-adoption of weed management and control practices, as well as the non-rotation of crops or incorrect use of the soil, may contribute to the increase of the soil seed bank for specific species of weeds, as what happened in this work with the Poaceae plants.

Cowpea stem diameter was lower at 77 days of coexistence (7.9 mm) when compared to the treatment at 77 days of control (9.5 mm), a difference of approximately 17% (Figure 4b). This reduction in diameter occurs because the crop tends to invest in vertical development in order to overlap its canopy over weeds in competition for light (CURY *et al.*, 2011). Epicotyl elongation is one of the consequences in the reduction of stem diameter, which can lead to plant lodging (PESSÔA *et al.*, 2017). A similar result was found for common bean cv. BRS supreme (*Phaseolus vulgaris* - Fabaceae), in which a reduction was observed in stem diameter as the period when the crop remained in the presence of weeds increased (MANABE *et al.*, 2015).

Figure 4. Number of pods per plant (a) and stem diameter (b) of cowpea cv. BRS Potengi as a function of periods of coexistence with weeds, winter crop, Januária-MG, 2016.

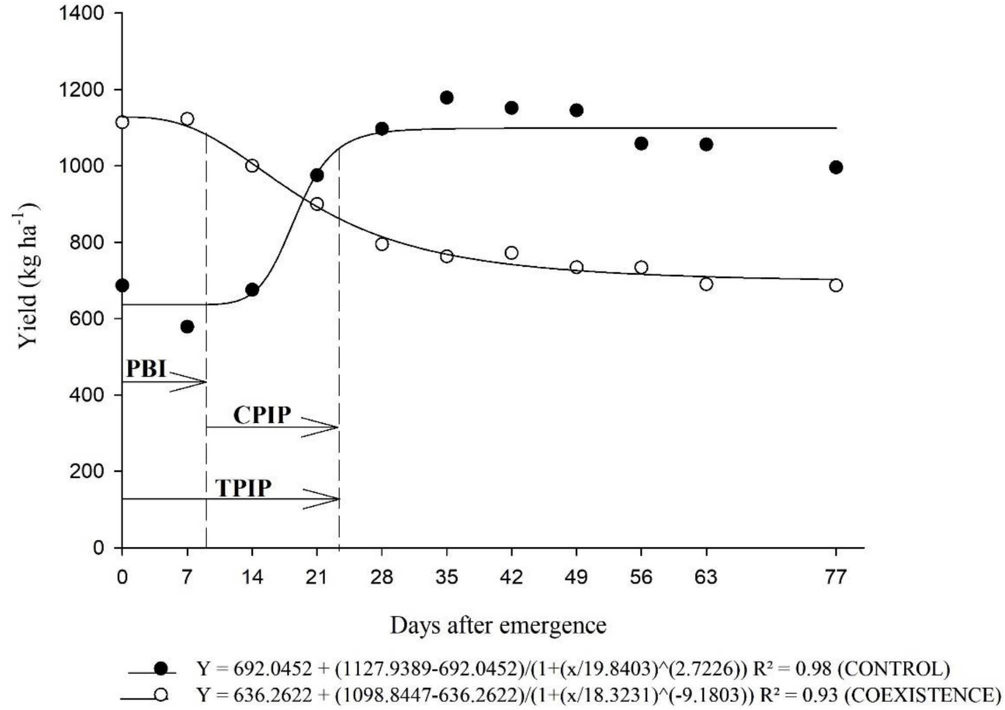


The number of pods in cowpea that coexisted with weeds at 77 DAE was reduced by more than 26% when compared to the treatment maintained free from interference

(Figure 4a). Freitas *et al.* (2009) verified that a reduction in the number of pods per plant is due to a lower inflorescence emission and flower abortion caused by the presence of weeds. This reduction in the number of pods has economic disadvantages. In fact, Oliveira *et al.* (2013) analyzed genotypic correlations and observed that this variable presents a high correlation and positive effect with yield.

Cowpea yield was reduced by 37% with interference during the entire crop cycle (692 kg ha^{-1}) when compared to the yield of plants without weeds during the cycle (1,099 kg ha^{-1}) (Figure 5). Yield reduction occurs due to competition for resources and environmental conditions, such as water, light, and nutrients (PITELLI, 1987). Cowpea cv. EVx91-2E-2 showed a 59.8% reduction in its yield when competing with lowland weeds in Amazonas (OLIVEIRA *et al.*, 2010). Almeida *et al.* (2017) obtained a yield of 3,107 kg ha^{-1} with cowpea cv. BRS Potengi in a study carried out in Uberaba, MG, with manual weeding at 15 and 30 DAE. Santos *et al.* (2016) obtained yields close to those found in the present study with cowpea cv. BRS Pajeú (1,170 kg ha^{-1}) and BR 17-Gurgueia (1,252 kg ha^{-1}) under irrigation in Januária, MG.

Figure 5: Yield of cowpea cv. BRS Potengi as a function of periods of control and coexistence with weeds, winter crop, Januária-MG, 2016.



Weed interference reduced cowpea production grown under edaphoclimatic conditions of Januária, northern Minas Gerais from 9 DAE, which corresponds to PBI. Weed control in cowpea var. BRS Potengi should be carried out up to 23 DAE, which is determined by grain yield of the crop submitted to increasing periods without interference and corresponds to TPIP (Figure 5). The PCPI for cowpea was 14 days, comprising the interval from the 9th (PBI) to the 23rd day (TPIP) (Figure 5).

A PBI of 9 DAE indicates that during this period, considering losses of up to 5% in relation to the best yield obtained (1,099 kg ha^{-1}), the crop can remain in the presence of weeds without significant losses to its yield. Among other factors, this behavior occurs because the crop still has reserves in the seed cotyledons, with no effective competition for environmental resources. Some authors have questioned the PBI indicated from the number of days after crop emergence (DAE), arguing that it would be inappropriate and suggesting other methodologies, including nitrogen level and phenological stages (VIDAL *et al.*, 2005). However, DAE is still the most used indicator for PBI. Freitas *et al.* (2009), Corrêa *et al.*

(2016) and Joaquim Júnior *et al.* (2021) worked with cowpea cv. BR 16 or BRS Guariba or Creole variety, observed that these cultivars can remain in coexistence with weeds by 11 and 8 DAE, respectively, without a significant reduction in crop yield. These differences are due to the density, competitive intensity, and initial germination fluxes of weeds.

The TPIP of 23 DAE indicates the period in which the crop is subject to weed interference. This period is represented in Figure 5 by the decreasing yield curve, which tends to stabilize from 23 DAE. It indicates that from that period, the interference caused by weeds no longer significantly affects yield because cowpea has developed in a way that allows it to compete for resources. CPIP is the period in which weeding or the residual effect of herbicides must be effective since weeds in the area at that moment will have the capacity to interfere with and reduce significantly crop yield (PITELLI, 1985). Freitas *et al.* (2009) observed a CPIP of 11-35 DAE for cowpea in Rio Grande do Norte. Corrêa *et al.* (2016) found a CPIP of 8-53 DAE for cowpea, but with a longer period of prevention and Joaquim Júnior *et al.* (2021) found a CPIP of 8-72 DAE for cowpea.

The chemical control of weeds is an economically viable tool for the producer against the negative interference exerted by the weed community. However, there are no herbicides registered for cowpea, which hampers weed control. Some authors have studied the selectivity of herbicides used in other crops, such as common bean and soybean, to cowpea seeking to recommend selective products that guarantee a similar efficacy to weed control (FONTES *et al.*, 2013; MANCUSO *et al.*, 2016; BANDEIRA *et al.*, 2017).

The number of grains per pod for cowpea in the presence of weeds showed no significant variation, with mean of 12.45 grains per pod. Pittelkow *et al.* (2009) and Borchartt *et al.* (2011) obtained similar results when working with soybean and common bean, which showed no significant number of grains per pod for different periods of coexistence.

The one thousand-grain weight of cowpea was similar for the periods of coexistence and control of weeds, with values ranging from 197.2 to 208.9 g (coexistence) and 199.6 to 208.9 g (control). This result is in accordance with those found by Corrêa *et al.* (2016) and Freitas *et al.* (2009), who worked with cowpea cv. BRS Guariba and BR 16, respectively, and observed that different periods of coexistence with weeds did not interfere with the variable one hundred-grain weight. This change is not observed since this characteristic is inherent to the cultivar, not being altered by crop management (FREITAS *et al.*, 2009). These results differ from those found by Oliveira *et al.* (2010), who observed a reduction in the one thousand-grain weight of different cowpea cultivars (BR IPEAN V69, BR8 Caldeirão, and EV x 91-2E-2) as a function of the periods of coexistence with weeds. In a study carried out with different herbicides, Mancuso *et al.* (2016) observed significant differences in the one hundred-grain weight for cowpea cv. BRS Nova Era, but without differences for the cultivar BRS Guariba. It indicates that this productive characteristic may or may not vary depending on weed management and the used cultivar.

The period prior to economic loss (PPEL) was 5 DAE. This low value indicates that it is economically viable to control weeds, in this case, due to the low cost of herbicides, reducing costs of control and increasing the profitability of production. Herbicides used in the simulation of the application cost were chosen based on selectivity since there are still no herbicides registered for this crop. According to Vidal *et al.* (2005), when PPEL is lower than PBI, the new TPIP would be higher than that already reported, meaning that the residual effect of the herbicides used should be long to avoid economic losses.

Conclusions

Weed interference in cowpea cv. BRS Potengi reduced stem diameter and number of pods per plant, resulting in a 37% loss in grain yield.

The found values allow the crop to remain in the presence of weeds for a period of 9 DAE. TPIP extends to 23 DAE and CPIP is between 9 and 23 DAE.

Cowpea is considered a rustic plant, but this characteristic does not exempt it from losses caused by weed interference when cultivated under irrigation between March and August in (blinded review), northern Minas Gerais. However, the results obtained here allow the producer to be aware of the correct times of weed control, reducing costs and making production viable.

Acknowledgments

To the National Council for Scientific and Technological Development (CNPq), and the Minas Gerais Research Foundation (FAPEMIG), and (blinded review), Instituto Federal do Norte de Minas Gerais (MG) for supporting the development and publication of this research. The authors declare that they have no conflict of interest.

References

ALMEIDA, F.S.; MINGOTTE, F.LC.; LEMOS, L.B.; SANTANA, M.J. Agronomic performance of cowpea cultivars depending on sowing seasons in the Cerrado Biome. **Revista Caatinga**, v.30, p.361-369, 2017. https://doi.org/10.1590/1983-21252017v30n211rc

ALVES, L.W.R.; LOPES, M.J.S. **Dinâmica populacional de plantas daninhas na transição do sistema plantio convencional para sistema plantio direto**. Macapá: Embrapa Amapá, 2014. (Boletim de Pesquisa e Desenvolvimento, 28),

ANDRADE JÚNIOR, A.S. **Cultivo de feijão-caupi**. Teresina: Embrapa Meio Norte, 2002. v.2, p180. (Sistemas de Produção, 57). Disponível em: https://www.infoteca.cnptia.embrapa.br/bitstream/doc/66591/1/sistemaproducao2.PDF. Acesso em: 25 nov. 2019.

BANDEIRA, H.F.S.; ALVES, J.M.A.; ROCHA, P.R.R.; STRUCKER, A.; TRASSATO, L.B.; DE JESUS VIEIRA, A. Crescimento inicial do feijão-caupi após aplicação de herbicidas em pós emergência. **Revista Brasileira de Herbicidas**, v.16, p.112-121, 2017. https://doi.org/10.7824/rbh.v16i2.503

BATISTA, P.S.C.; OLIVEIRA, V.S.; SOUZA, V.D.; CARVALHO, A.J.; ASPIAZÚ, I. Phytosociological survey of weeds in erect prostrate cowpea cultivars. **Planta Daninha**, v.35, p.1-9, 2017. https://doi.org/10.1590/S0100-83582017350100031

BASTOS, E.A.; FERREIRA, V.M.; DA SILVA, C.R.; DE ANDRADE JÚNIOR, A.S. Evapotranspiração e coeficiente de cultivo do feijão-caupi no Vale do Gurguéia, Piauí. **Irriga**, v.13, p.182-190, 2008. https://doi.org/10.15809/irriga.2008v13n2p182-190

BORCHARTT, L.; JAKELAITIS, A.; VALADÃO, F.C.D.A.; VENTUROSO, L.A.C.; SANTOS, C.L.D. Períodos de interferência de plantas daninhas na cultura do feijoeiro-comum (*Phaseolus vulgaris* L.). **Revista Ciência Agronômica**, v.42, p.725-734, 2011. https://doi.org/10.1590/S1806-66902011000300019

BEZERRA, A.A.C.; NETO, F.A.; NEVES, A.C.; MAGGIONI, K. Comportamento morfoagronômico de feijão-caupi, cv. BRS Guariba, sob diferentes densidades de plantas. **Revista de Ciências Agrárias**, v.55, p.184-189, 2012. https://doi.org/10.4322/rca.2012.059

BRASIL. Ministério da Agricultura, Pecuária e Abastecimento. Secretaria de Defesa Agropecuária. **Regras para análise de sementes**. 2009. Disponível em: http://www.agricultura.gov.br/assuntos/insumos-agropecuarios/arquivos-publicacoes insumos/2946_regras_analise__sementes.pdf. Acesso em: 25 nov. 2019.

CONAB. **Acompanhamento da safra brasileira. Safra 2021/22**. 9° Levantamento, junho, v.9, n.9, 2022. Disponível em: www.conab.gov.br

CORRÊA, M.J.P.; ALVES, G.L.; ROCHA, L.G.F.; SILVA, M.R.M. Períodos de interferência de plantas daninhas na cultura do feijão-caupi. **Revista de Ciências Agroambientais**, v.13, p.50-56, 2016.

CURY, J.P.; SANTOS, J.B.; VALADÃO SILVA, D.; CARVALHO, F.P.; BRAGA, R.R.; BYRRO, E.C.M.; FERREIRA, E.A. Produção e partição de matéria seca de cultivares de feijão em competição com plantas daninhas. **Planta Daninha**, v.29, p.149-158, 2011. https://doi.org/10.1590/S0100-83582011000100017

FONTES, J.R.A.; OLIVEIRA, I.J.; GONÇALVES, J.R.P. Seletividade e eficácia de herbicidas para cultura do feijão-caupi. **Revista Brasileira de Herbicidas**, v.12, p.47-55, 2013. https://doi.org/10.7824/rbh.v12i1.214

FREITAS, F.C.L.; MEDEIROS, V.F.L.P.; GRANGEIRO, L.C.; SILVA, M.G.O.; NASCIMENTO, P.G.M.L.; NUNES, G.H. Interferência de plantas daninhas na cultura do feijão-caupi. **Planta Daninha,** v.27, p.241-247, 2009. https://doi.org/10.1590/S0100-83582009000200005

FROTA, K.D.M.G.; SOARES, R.A.M.; ARÊAS, J.A.G. Composição química do feijão-caupi (*Vigna unguiculata* L. Walp), cultivar BRS-Milênio. **Revista Ciência e Tecnologia de Alimentos**, v.28, p.470-476, 2008. https://doi.org/10.1590/S0101-20612008000200031

GUERRA, J.V.S.; CARVALHO, A.J.D.; MEDEIROS, J.C.; SOUZA, A.A.D.; BRITO, O.G. Agronomic performance of erect and semi-erect cowpea genotypes in the north of Minas Gerais, Brazil. **Revista Caatinga**, v.30, p.679-686, 2017. https://doi.org/10.1590/1983-21252017v30n316rc

JOAQUIM JÚNIOR, C.Z.; BARBOSA, I.J.; DA COSTA, Y.K.S.; SANÓ, L.; NBALI, N.N.; DA SILVA, L.G.C. Rendimento de feijão-caupi sob interferência de plantas daninhas Cowpea yield under weed interference. **Brazilian Journal of Development**, v.7, n.12, p.120939-120950, 2021. https://doi.org/10.34117/bjdv7n12-727

KOTTEK, M.; GRIESER, J.; BECK, C.; RUDOLF, B.; RUBEL, F. World map of the Köppen-Geiger climate classification updated. **Meteorol Zeitsch**, v.15, p.259-263, 2006. https://doi.org/10.1127/0941-2948/2006/0130

KUVA, M.A.; PITELLI, R.A.; CHRISTOFFOLETI, P.J.; ALVES, P.L. Períodos de interferência das plantas daninhas na cultura da cana-de-açúcar- Tiririca. **Planta Daninha**, v.8, p.241-251, 2000. https://doi.org/10.1590/S0100-83582000000200006

LACERDA, M.L.; SILVA, D.L.S.; ASPIAZÚ, I.; DE CARVALHO, A.J.; DE OLIVEIRA, S.M.; SILVA, R.F. Fitossociologia de plantas daninhas em cultivo de feijão-caupi no semiárido mineiro. **Nativa**, v.9, n.5, p.528-535, 2021. https://doi.org/10.31413/nativa.v9i5.11210

LORENZI, H. **Manual de identificação e controle de plantas daninhas**: plantio direto e convencional. 7. ed. Nova Odessa: Instituto Plantarum, 2014.

MANABE, P.M.S.; MATOS, C.D.C.; FERREIRA, E.A.; SILVA, A.F.; SILVA, A.A.; SEDIYAMA, T.; SILVA, C.T. Efeito da competição de plantas daninhas na cultura do feijoeiro. **Bioscience Journal**, v.31, p.333-343, 2015. https://doi.org/10.14393/bj-v31n2a2015-22271

MANCUSO, M.A.C.; AIRES, B.C.; NEGRISOLI, E.; CORRÊA, M.R.; SORATTO, R.P. Seletividade e eficiência de herbicidas no controle de plantas daninhas na cultura do feijão-caupi. **Revista Ceres**, v.63, p.25-32, 2016. https://doi.org/10.1590/0034-737X201663010004

MARCONDES, A. Distribuidora de defensivos agrícolas. **Agron: Agronegócios online**. Janeiro, 2017. Disponível em: https://www.agron.com.br/publicacoes/anuncios/classificados/2010/06/05/011062/distribuidora-de-defensivos-agricolas-preco-deinter net.html. Acesso em: 25 nov. 2019.

MEDEIROS, I.F.S.; SILVA, P.S.L.; SOUSA, R.P.D.; SILVA, J.D.; SILVA, R.M.D. Avaliação de variedades de feijão-caupi selecionadas sob competição com plantas daninhas. **Revista Ciência Agronômica**, v. 52, n.4, e20207202, 2021. https://doi.org/10.5935/1806-6690.20210070

MESQUITA, H.C.; DE FREITAS, F.C.L.; FREIRE FILHO, F.R.; DA SILVA, M.G.O.; CUNHA, J.L.X.L.; DOS SANTOS RODRIGUES, A.P.M. Eficácia e seletividade de herbicidas em cultivares de feijão-caupi. **Revista Brasileira de Herbicidas**, v.16, p.50-59, 2017. https://doi.org/10.7824/rbh.v16i1.505

NORSWORTHY, J. Soybean canopy formation effects on pitted morningglory (*Ipomoea lacunosa*), common cocklebur (*Xanthium strumarium*), and sicklepod (*Senna obtusifolia*) emergence. **Weed Science**, v.52, p.954-960, 2004. https://doi.org/10.1614/WS-04-043R

OLIVEIRA, O.M.S.D.; SILVA, J.F.D.; FERREIRA, F.M.; BORGES, C.V. Associações genotípicas entre componentes de produção e caracteres agronômicos em feijão-caupi. **Revista Ciência Agronômica**, v.44, p.851-857, 2013. https://doi.org/10.1590/S1806-66902013000400023

OLIVEIRA, O.M.S.; SILVA, J.F.; GONÇALVES, J.R.P.; KLEHM, C.S. Período de convivência das plantas daninhas com cultivares de Feijão-Caupi em Várzea No Amazonas. **Planta Daninha**, v.28, p.523-530, 2010. https://doi.org/10.1590/S0100-83582010000300009

PAULO, E.; KASAI, F.S.; CAVICHIOLI, J.C. Efeitos dos períodos de competição do mato na cultura do amendoim: ii. safra das águas. **Bragantia**, v.60, p.27-33, 2001. https://doi.org/10.1590/S0006-87052001000100004

PESSÔA, U.C.M.; DE OLIVEIRA, K.J.A.; DOS SANTOS SOUZA, A.; DA SILVEIRA MUNIZ, R.V.; DE ARAÚJO NETO, A.G.; PIMENTA, T.A. Desempenho fisiológicos e crescimento do feijão-caupi, sob manejos de plantas daninhas. **Revista Verde de Agroecologia e Desenvolvimento Sustentável**, v.12, p.246-250, 2017. https://doi.org/10.18378/rvads.v12i2.5067

PITELLI, R.A. Interferência de plantas daninhas em culturas agrícolas. **Informe Agropecuário**, v.11, p.16-27, 1985.

PITELLI, R.A. Competição e controle das plantas daninhas em áreas agrícolas. **IPEF Série Técnica**, v.4, p.1-24, 1987.

PITELLI, R.A.; DURIGAN, J.C. Terminologia para períodos de controle e de convivência das plantas daninhas em culturas anuais e bianuais. *In*: CONGRESSO BRASILEIRO DE HERBICIDAS E PLANTAS DANINHAS, 15. **Resumos...** Piracicaba: SBHED, 1984. p.37.

PITTELKOW, F.K.; JAKELAITIS, A.; CONUS, L.A.; DE OLIVEIRA, A.A.; DE OLIVEIRA GIL, J.; DE ASSIS, F.C.; BORCHARTT, L. Interferência de plantas daninhas na cultura da soja transgênica. **Global Science Technology**, v.2, p.38-48, 2009.

R DEVELOPMENT CORE TEAM. **A Language and Environment for Statistical Computing**. Vienna: R Foundation for Statistical Computing, 2016. Disponível em: https://www.r-project.org/. Acesso em: nov. 2017.

SANTOS, L.L.; FILHO, A.G.; LEANDRO, R.I.; DE CARVALHO, F.M.; GOMES, P.L.; SOARES, A.S. Desempenho agronômico de variedades de feijão-caupi produzidas em regime irrigado e sob déficit hídrico no semiárido mineiro. **Revista Agri-Environmental Science**, v.2, p.1-14, 2016. https://doi.org/10.36725/agries.v2i1.197

SILVA, C.; SILVA, A.F.D.; VALE, W.G.D.; GALON, L.; PETTER, F.A.; MAY, A.; KARAM, D. Interferência de plantas daninhas na cultura do sorgo sacarino. **Bragantia**, v.73, p.438-445, 2014. http://dx.doi.org/10.1590/1678-4499.0119

SILVA, A.F.A.; LIMA, R.S. Interferência de plantas daninhas sobre plantas cultivadas. **Agropecuária Científica no Semiárido**, v.8, p.1-6, 2012.

VIDAL, R.A.; FLECK, N.G.; MEROTTO JR, A. Período anterior ao dano no rendimento econômico (PADRE): nova abordagem sobre os períodos de interferência entre plantas daninhas e cultivadas. **Planta Daninha**, v.23, p.387-396, 2005. https://doi.org/10.1590/S0100-83582005000300001