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Canola desiccation at different stages of pods maturation[1]

Dessecação de canola em diferentes pontos de maturação das síliquas

Leandro Paiola Albrecht[2]; Fábio Henrique Krenchinski[3]; Henrique Fabrício Placido[3]; Marco Aurélio Riedi Bomm[4]; Vilson Luis Kunz[2]; Ângelo Henrique Canan Korber[3]; Renato Rodrigo Bieler[3]

Abstract - Canola has outstanding as a great winter crop option and nowadays occupies the fourth place among oil species in production. One of the major difficulties in canola cultivation is the harvest season, because its pods do not show maturation uniformity. A technique that may be used to facilitate the harvest is the use of desiccants. Therefore, this study aimed to evaluate desiccation effect, in distinct pods maturation in canola crop. The work was conducted in field conditions, in Terra Roxa County, Parana State, by using a randomized complete blocks design with four replications. Treatment consisted of paraquat application (2.5 L ha^{-1} of Gramoxone 200®), sprayed at different periods of crop development, from three percentages of maturate pods, 30, 45 and 75% (visual assessment), plus a check without desiccant herbicides. There were no significant differences for yield and mass of a thousand seeds. In relation to seeds moisture, significant differences were observed, with 75% of mature pods occurring with inferior moisture.
Keywords: desiccation anticipation, improved harvest, canola

Resumo - A canola vem se destacando como ótima opção de cultura de inverno e hoje ocupa a quarta colocação mundial entre as oleaginosas em produção. Uma das grandes dificuldades no cultivo da canola é a época de colheita, pois suas síliquas não amadurecem de forma uniforme. Uma técnica que pode ser usada para favorecer a colheita é o uso de dessecantes. Com isso, o presente trabalho teve como objetivo avaliar o efeito da dessecação, em diferentes maturações das síliquas na cultura da canola. O trabalho foi realizado a campo no município de Terra Roxa - PR, utilizando-se o delineamento experimental de blocos ao acaso com quatro repetições. Os tratamentos foram constituídos da aplicação de paraquat (2,5 L ha^{-1} de Gramoxone 200®), pulverizados em épocas distintas do desenvolvimento da canola, a partir de três porcentagens de síliquas maduras, 30, 45 e 75% (avaliação visual), mais uma testemunha sem aplicação de herbicidas dessecantes. Não houve diferença significativa para produtividade e massa de mil sementes. Para o fator umidade das sementes ocorreu diferença significativa, com 75% de síliquas maduras ocorrendo nas menores umidades.
Palavras-chaves: antecipação da dessecação, melhora na colheita, canola

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[2] Professor Adjunto da Universidade Federal do Paraná - Setor Palotina. R. Pioneiro, 2153, Jardim Dallas, CEP 85950-000. Palotina, PR. E-mail: lpalbrecht@yahoo.com.br; vilsonkunz@ufpr.br;
[3] Acadêmicos de Agronomia pela Universidade Federal do Paraná - Setor Palotina, E-mail: fabiohk2@gmail.com; placido.agronomia@gmail.com; angelohckorber@hotmail.com e renatobieler@gmail.com.
[4] Gerente de Negócios, Bomm Agronegócios. R. Getúlio Vargas, 959, Centro, CEP: 85950-000. Palotina, PR. marco@bomm.com.br.

Introduction

Canola is an oilseed crop belonging to cruciferae family, developed through genetic improvement of oilseed rape (*Brassica napus* L. and *Brassica campestris*) in order to obtain varieties and hybrids with less than 2% of erucic acid in oil and less than 30 micromoles of glucosinolates per gram of dry solid in the air, therefore, best for food (Santos et al., 2000). In its seeds, it shows 45 to 50% of oil and 34 to 38% of protein, depending on the genotype, presenting great economic importance in oil production, biodiesel and bran production for rations manufacture (Baier & Roman, 1992).

This species has been outstanding among winter crops such as the one that represents the greatest economic importance in the world scene, occupying nowadays the fourth position among oilseeds in production, mainly by high oil content and grain chemical composition, besides high protein content in bran (Domiciliano & Santos, 1996). In addition, represents an attractive option for cropping systems predominating in southern Brazil, as another alternative for winter crop, being also indicated to compose crop rotation schemes, as well as for agricultural diversification and soil vegetation cover in winter period (Baier & Roman, 1992).

It stands out not only as a crop of economically important, but is also the subject of researches aiming better conditions for development and consequently greater yield. Some researches with potassium fertilization are commonly cited, and there is information about the nutrient importance for this crop development. There was increased over physiological quality, in relation to seeds quality when applied at different levels (Avila et al., 2004). Besides it, still regarding to the evaluation of seeds quality, tests conducted in laboratory conditions, such as germination, first count of germination, electric conductivity and accelerated ageing were considered to be the most efficient to detect differences between canola seeds portions, in relation to seedlings emergence potential in field conditions (Avila et al., 2005).

Fruit is a small pod (capsular), that presents dehiscence, and the seeds when mature, fall to the ground easily. Canola seed reaches physiological maturation, with moisture degree around 35%, from that water loses water until it reaches harvest point (Emater, 2003).

Canola (*Brassica napus* L.) yield is related to direct production components, plant density, number of pods per plant, number of seeds per pod and grain mass (Thomas, 2003).

Harvest is considered the most critical stage in canola cultivation, since pods do not form and maturate at the same time, with maturation occurring from bottom to top on main stem and secondary branches. As soon as maturation occurs, pods open, since are fruits showing dehiscence, causing losses for mature seeds fall in the soil (Coedeiro, 1999). According to Motta et al., (2007) damages are greater if the effects of environment, such as, climate and winds were intense in the final development stage of this crop.

For Bragachini et al. (1991) there are several harvest systems for canola, and one of them is direct, by applying chemical desiccant, when 90% of grains reach physiological maturation (around 30% moisture), followed by the harvest with self propelled harvester. However, in field conditions, the definition of this maturation point is complex, requiring standard establishment more simple and adequate to the farmers.

Early chemical desiccation has been used in lately years as an alternative by farmers in order to reduce losses in maturation stage, besides aiming superior harvest uniformity. However, limiting factors are still found in relation to the ideal stage for desiccation herbicides application, aiming to propitiate satisfactory harvest, uniformed and without excessive losses with dehiscence and with ideal grain moisture level.

According to nowadays scenario and difficult for discovering a right definition of physiological maturation point in field conditions, a viable alternative would be spraying desiccant herbicides from visual identification of maturate pods.

The objective of this study was to evaluate desiccation effect, in different maturation stages of pods, in production components, in canola crop.

Material and Methods

The present work was conducted in field conditions in Terra Roxa County, Parana State, with soil classified as Red Latosoil distropherric clay texture (Embrapa, 2006) and climate classified as Cfa according to Köpen classification

Experimental design was randomized complete blocks with four repetitions. Treatments constituted by paraquat (Gramoxone 200®) in dose of 500 g a.i. ha^{-1}, applied in three distinct periods of canola development, at 30, 45 and 75% of maturate pods, according to visual evaluation and a check without herbicide application.

Parameter for visual assessment and, aiming to find an exact standard in field conditions, determining application moment, in the beginning of activities it was counting maturate and no maturate pods, establishing the percentage in fieldwork.

Application was conducted with a costal sprayer, O_2 pressurized, presenting a bar with six spray nozzles of standard flat fan, 110.02 series with work pressure of 2 kgf cm^{-2} with spray volume of 200 L ha^{-1}.

Canola genotype used in experiment was Hyola 61 hybrid. Fertilization consisted of 300 Kg ha^{-1} of NPK 10-20-20 and other management (except for pre harvesting dissection) followed recommendation of Tomm et al. (2009).

Harvest was conducted when approximately 100% of pods were totally dry. Harvested area (useful area) was around $2.8m^2$, and after this procedure, it was conducted a threshing in stationary machine. Seeds were clean with the aid of sieves and stored in multipholiate kraft paper bags. According to grain yield, moisture was corrected to 13% and yield calculated in kg ha^{-1}. Moisture content of seeds was assessed immediately after threshing, by the oven official method (105°± 3°C/24 hours) (Brazil, 2009).

Other variables were also analyzed: dehiscence (intense, moderate and little present by visual assessment); maturation at harvest (percentage of dried plants – plants complete morphological maturation); no maturate grains (absent, incipient presence, expressive presence) and mass of 1000 seeds (Brazil, 2009). Data were submitted to variance analysis (F test - $p \leq 0.05$) and means compared by Tukey test ($p \leq 0.05$).

Results and Discussion

Desiccation with 75% of mature pods provided little pods dehiscence joint to the check (Table 1), since desiccation that occurred at 30% of mature pods allowed an intense dehiscence, attributed to great anticipation of desiccation, enabling pods drying for a longer time period. In relation to operational standpoint in harvest, a minor loss of dehiscence results in a lower seed losses, allowing greater income to farmers.

Treatments of 30 and 45% made it possible 100% of mature plants at harvest time (Table 1), fact assigned to the period in what plant was desiccated in field. Check or control showed 85% of plants with complete morphological maturation at harvest time.

According to Tomm (2005) canola maturation begin from inferior branches, following in direction to the superior ones in function of indeterminate growth development. Tomm (2005) highlights that it may be observed in the same plant, mature and no mature pods, and, in extreme conditions, even the presence of flowers. This high desuniformity results in crop losses because of grain fall underground, reaching values superior to 30% in grain yield reduction, mainly if environment effects such as intense winds and rainfall occur in the final stages of crop maturation.

Check showed the expressive presence of no maturates grains (Table 1) and the first treatment (30%) did not present it. This variable may be easily correlationated to maturation at harvest moment, when both treatments over showed 85% and 100% of maturation, respectively. Since pods in check did not present totally mature at harvest moment, became possible a higher occurrence of no maturate grains and these ones reduce grains quality, mainly interfering in the quality of produced oil, an essential characteristic for biodiesel industry.

Table 1. Dehiscence, harvest maturation and no maturate grains in canola hybrid (Hyola 61), desiccated with paraquat in distinct stages of pods maturation (30, 45 and 75%), in Terra Roxa County, Parana State.

Application period	Dehiscence	Harvest maturation	No maturate grains
Check	Less presence present	85%	Expressive presence
30% [1]	Intense	100%	Ausence
45%	Moderated	100%	Insipient presence
75%	Less presence	95%	Insipient presence

[1]Percentage of maturate pods for desiccation.

For the variable mass of a hundred seeds there was not significant difference ($p \leq 0.05$) among treatments; however it was observed superior values, especially when desiccating was applied with pods around 45% of maturation (Figure 1). Plots desiccated at 75% and a check showed means with the same value. The smallest mass of thousand seeds was observed when drying occurred with 30% of mature pods. These trends observed among means, corroborate with the study conducted by Motta et al. (2007), that evaluating distinct periods of canola desiccating, ranging since periods near to the harvest up to the longest ones (0 to 54 days), observed that as longer the period before harvest, inferior the mass of a hundred seeds, as for instance, desiccation with periods really far from harvest may become damage to canola crop, not favor in such cases, the desiccating.

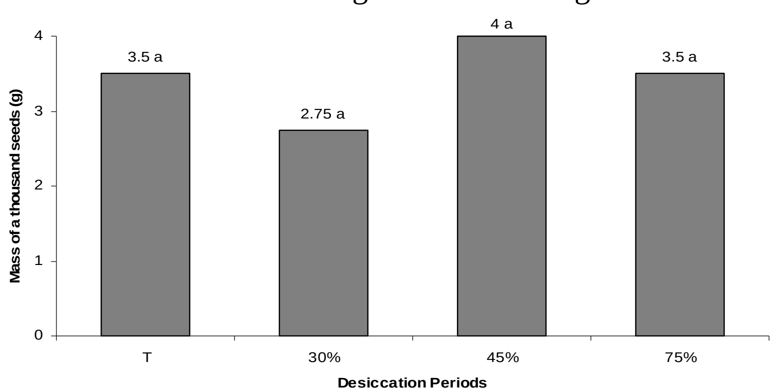

Figure 1. Mass of a thousand seeds of canola hybrid (Hyola 61), desiccated with paraquat in distinct pods maturation periods (30, 45 and 75%), in Terra Roxa County, Parana State. Means followed by the same letter do not differ from each other by Tukey test ($p \leq 0.05$). $F_{cal} = 0.447^{NS}$; CV% = 31,52; DMS = 2,39. (^{NS} = No significant).

For grain yield characteristic it was not observed significant differences ($p \leq 0.05$) among treatments (Figure 2), corroborating with data obtained by Marchiori et. al. (2002), however desiccating at 75% obtained, numerically, the best mean among all treatments. Check showed the second best mean. As observed for mass of a hundred seeds the desiccating com 30% of maturate pods, showed the lowest value. This may be explained because of incomplete filling grains, by possible inferior oil and protein content and, visible dehiscence observed in field conditions at harvest moment. However, it is important to emphasize that conjectures were based in means observations, so that only tendencies, without using statistical inference.

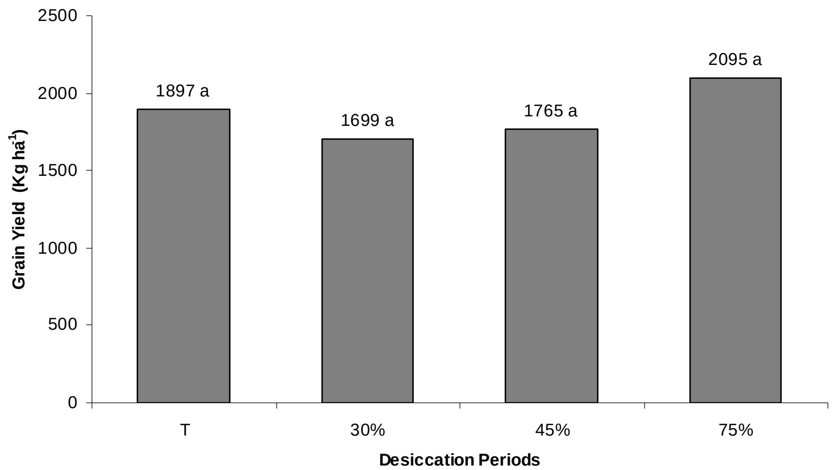

Figure 2. Canola yield (Hyola 61), desiccated with paraquat in distinct periods of pods maturation (30, 45 and 75%), in Terra Roxa County, Parana State. Means followed by the same letter, do not differ from each other by Tukey test ($p \leq 0.05$). $F_{cal} = 0.229^{NS}$; CV% = 14.21; DMS = 585.20. (^{NS} = No significant).

In studies conducted by Marchiori et. al. (2002), with the effect of four products in desiccation, over protein content in canola grain, it was observed that glufosinate ammonium and carfentrazone-ethyl presented negative effect in relation to the check and paraquat, becoming paraquat, for canola crop, one of the best herbicides for its desiccation. However for oil content in grains, Marchiori et. al. (2002) did not observe significant differences among treatments, outstanding that desiccation does not affect, in this case, oil content in grains, characteristic really appreciated for biodiesel production.

The same results may be observed in other crops, as for instance, soybean RR crop, in study conducted by Albrecht et al. (2011), evidencing the modification potential in chemical composition of seeds, by changing proteins content, when using glyphosate at crop reproductive period, without occurring significant results for seed oil percentage. In studies conducted by Motta et. al., (2007), yield factor was observed with linear regression, in each day of canola harvest anticipate, through desiccation, reduces in 28.46 kg ha^{-1} grain yield. In this way, it is necessary to define an adequate positioning for harvest promoting. Studying this subject, Motta et. al., (2007b) observed the existence of desiccation viability in a period anterior to harvest, without desiccation and this one may be around eight days. According to Silva (2011) there is possibility of use in anticipate desiccation in canola crop and the most adequate moment for its use corresponds to eight days before harvest natural period, as suggested by Tomm et al. (2009). Previously desiccation to this established period may cause damage to grain yield and its components, also including grains percentage with oil presence.

Phenotypical observation of maturate pods would be potentially the best position to be considered in the process of desiccating use, since maturation for harvest, in days, may range according to genotypes and environmental conditions, as temperature and insulation, fact that is supported from the interference of researches results (Motta et. al., 2007b).

In moisture evaluation occurred significant differences for application at 75% of maturate pods, making it possible lower harvest moisture than other application. Check showed the highest moisture among all treatments (Table 2).

Table 2. Seeds moisture of canola seeds (Hyola 61), desiccated in distinct periods of pods maturation (30, 45 and 75%), in Terra Roxa County, Parana State.

Application periods	Moisture (%)
Check	16.27 a
30%	15.02 a
45%	15.67 a
75%	11.50 b
CV%	6.81

Same small letters, in columns, do not differ statistically by Tukey Test ($p \leq 0.05$). $F_{cal} = 0.0003^{*}$; CV% = 6.81; DMS = 2.19. (* = significant)

This moisture may interfere in characteristics such as harvest and storage, or even in grain oil quality. Besides scarce studies relating to canola crop, there is information that for maize crop, speed changing of lipids in seeds depends on moisture, temperature and storage period (Biaggioni et al., 2005). For soybean, a crop highly susceptible to fatty acid oxidation, if grain were dry storage (around 13% of moisture) lipoxigenase enzyme does not catalyze oxidation of lipid substrate, maintaining its quality in time, but in conditions of higher storage moisture, lipid and grains quality reduce (Nelson et al., 1976).

Harvest seeds with high moisture content may favor incidence of fungus, and its effect in seeds quality is a sequence, that follows approximately these stages: embryo death or weakness; embryo discoloration or in whole seed; fungus presence; warming; total putrefaction and combustion (Dhingra, 1985). Besides it, may happen discounts at delivery moment in specialized factories for canola grain destination.

Desiccation at 75% of maturate pods promoted maturation more homogeneous, resulting in lower grains moisture, consequently grains with the same color and same moisture content without ranging. Check or control showed an expressive quantity of no maturates grains and without uniformity in its development, what resulted in high moisture percentage.

Conclusions

According to presented results, desiccation did not influence productive parameters of canola crop.

Seeds moisture was influenced by desiccation period. It is possible to infer that desiccating applications are valid when applied in the nearest period of harvest, with 75% of maturate pods.

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