The critical period of weed control in winter canola (*Brassica napus* L.)

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Abstract

In order to determine the critical period of weed control in winter canola (Okapy Double Zero), an experiment was carried out at research field of Tarbiat Modarres University (placed in Tehran west, Iran) on 2004-2005 growing season. Randomized complete block design with 4 replications were used. Fourteen treatments divided into two sets. In first set of treatments, the crop was kept weed-free until 2, 4, 6 and 8 leaves, inflorescence emergence, 50% silique appearance and harvest stage. In second set of treatments, weeds were permitted to grow with the crop until above mentioned stages. In this study the critical period of weed control was determined based on natural population of weeds which emerged from soil seed bank. Results showed a critical time of weed control in 25 days after emergence (between four and six-leaf stage) with 5% accepted yield loss. Therefore weed control in this time could provide the best result and reduced the rapeseed yield loss.

Key words: Weed control, critical period, canola, interference, *Brassica napus* L.

Introduction

Determining the critical period of weed control (CPWC) in crops is one of the earliest steps for designing an integrated weed management system (Swanton and Weise, 1991). This period has been defined as an interval in the life cycle of the crop when it must be kept weed-free to prevent yield loss. The critical period of weed control consists of two sub-periods; (1) the critical weed-free period: which is the maximum length of time weeds emerging with a crop can be allowed to grow until they begin to cause unacceptable yield losses, and (2) the critical weed-removal period: which is the minimum length of time weeds that emerge after a crop must be removed so that unacceptable yield losses do not occur. This concept helps in determining the most effective time for non-residual post-emergence herbicides application, reduces the practice of season-long residual herbicides, and eliminates unnecessary late application of herbicides. The critical periods are defined relative to a crop growth stage to account for environmental variation. The critical period is based on a yield loss due to weed interference of no more than 5%. In other words, the crop has to be weed-free during these stages to prevent a yield loss of more than 5%. Weed species and density has dramatic effect on duration of CPWC. Crop competitiveness against different weed species is not the same (Ehteshami and Cheichi, 2000). CPWC influenced by weed density, competition duration, spatial distribution, population diversity, seed bank richness, environmental condition and cultural practices (Karimi Nezhad, 2003). Van Acker (2001) Showed that CPWC in spring canola occurred between four to six-leaf growth stages. Winter canola growing season in Tehran indicate that late emerged summer weeds on early autumn and those emerged in spring are able to affect different stages of canola growth including seedling emergence, vegetative growth, establishment, rosette, stem elongation, inflorescence emergence, flowering duration and grain yield. Weeds emerging after the critical period may only be a concern for interference in harvest operations and weed seed production. Therefore, weed management is a continuous process that involves an assessment of the types of weed species present, their dynamics of emergence, their distribution, stage of development and their potential for seed production. The main object of this paper is to introduce CPWC of winter canola (*Brassica napus* L.) in Tehran province.

Materials and methods

Experiment was carried out during 2004-2005 growing season in the research field of Tarbiat Modarres University (College of Agriculture) which located at Tehran 35° 43´ N and 51° 8´ E with approximately 1245 meter above sea level. This Location has mean annual precipitation as 247.4 mm. Soil texture was sandy loam.

Fourteen treatments were arranged in a RCBD with four replications. Canola seeds (Okapy Double Zero) had sown on Sep. 16^{th} Each plot has 5 rows, of 4 m long with 30 cm row space; treatments were set in 2 groups: Control period and Interference period. In control treatments canola kept weed free from emergence time to two-leaf stage (V2), four-leaf stage (V4), six-leaf stage (V6), eight-leaf stage (V8), Inflorescence emergence (IE), %50 of silique set (%50 SS) and final harvest (H)[A standardized growth stage scale developed by BASF, Bayer Ciba- Geigy and Hoechst called BBCH decimal system provides an accurate and simplified approach to describing canola growth stages]. In Interference treatments all weed species were allow to grow in canola field till above mentioned growth stages of canola. Seed harvested end of season and grain yield reported with %14 humidity.

Gompertz (equation 1) and logistic (equation 2) functions (Ratkowsky 1990) were used to evaluate weed control and interference duration respectively, to canola grain yield.

(Equation 1): $$Y = Ae^{(-Be^{(-KT)})}$$

Y: Grain yield (percent of weed free plot)
A: The yield asymptote
e: The base of natural logarithm
T: Time in DAE
B, *K*: Parameters that determine the shape of the curve

(Equation 2): $$Y = [(1/De^{[K(T-X)]} + F) + (F-1)/F] \times 100$$

Y: Grain yield (percent of weed free plot)
T: Time in DAE
X: Point of inflection
D, *K*, *F*: Constant coefficients

In order to predict constant coefficients in above functions a mathematical computer program (CURVE EXPERT) was used.

Results and discussion

A, *B* and *K* values of Gompertz function (table 1) and *X*, *D*, *K* and *F* value of logistic function (table 2) were estimated using grain yield data in the weed free plot, control and interference treatments.

Table 1. Estimated values of Gompertz constants.

Constant	A	B	K
Estimated values	97.6729	3.8120	0.2299

Table 2. Estimated values of Logistic function.

Constant	F	K	D	X
Estimated values	5.3730	0.0825	0.4608	9.0770

Regression and standard deviation for fitting Gompertz curve (canola yield against weed control duration) estimated as %99.58 and 3.9 respectively. These values for logistic curve (canola yield against interference duration) rated as %95.8 and 11.5 respectively (figure 1).

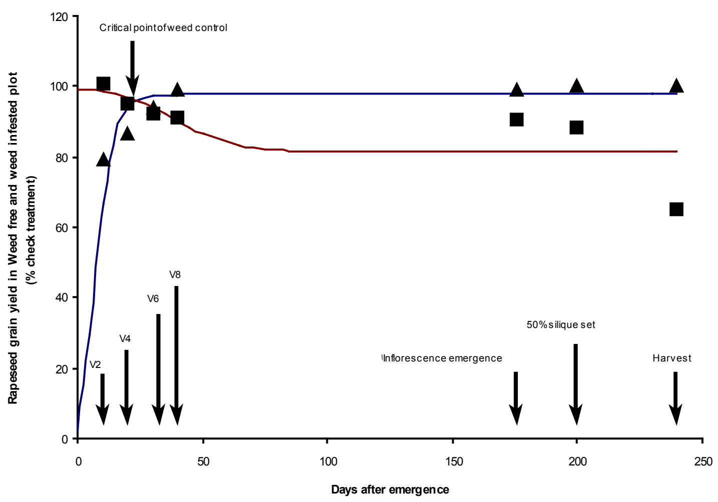

Figure 1. Critical period of weed control in canola.

It seems vegetative phase of canola is very sensitive to weed competition because in this stage canola seedling are too small and have a simple canopy. Early emerged weed could take this opportunity to suppress the crop.

As it clear in figure (1) CPWC in canola is too short as a critical point, on the other words critical point of weed control coincided to 25 DAE. In this time canola seedlings were too small and their competitiveness to early emerged weed was low. From the phenological point of view critical period of weed control were settled between four leaf stage (19DAE) and six-leaf stage (32 DAE). Weeds emerging after the critical period may only be a concern for interference in harvest operations and weed seed production. Van Acker *et al.,* (2001) reported the same period for spring canola. Weed control in this period inhibit the significant canola yield loss. High leaf area and plant density of canola in autumn growth season were the main features decreased duration of critical period of weed control (Data not Shown).

It could be stated frequency and variation of weed species in local circumstances will influence the result. Weed invasion period in this experiment divided to two distinct times, the first, coincident with canola emergence and the second was close to stem elongation. In first stage emerged weed were often summer annuals which destroyed starting cold weather. In second stage spring annuals like as *sisymbrium altissimum* confronted to established canola population. Dominant species in our experiment was the common purslane (*Portulaca oleracea*), and has %79.4 of weed biomass in each plot. Other important species in terms of their biomass were wheat (*Triticum aestivum*), tumble mustard (*Sisymbrium altissimum*), common lambsquarter (*Chenopodium album*), redroot pigweed (*Amaranthus retroflexus*), and jimsonweed (*Datura stramonium*). Canola produced high leaf area and completely covered the ground area, so suppressed the weed seedling easily. Altogether results indicate that exist weed in this experiment were not able to affect trend of dry matter accumulation and leaf area expansion of canola. Because summer annuals were killed under cold weather of end autumn and spring weed failed in competition with canola because of stem elongation and fast closure of canola canopy in early spring, therefore under Tehran climatic condition natural population of weed s in canola fields had no decreasing effect on grain yield (Figure 1). Therefore chemical weed control (using herbicides) is not necessary and mechanical weed control in 25 DAE offer the acceptable weed management (cost efficient and environmentally health).

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