Crop residue amount and distribution in direct seeding: influence on emergence, yield and yield components of spring rapeseed

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Abstract

Rapeseed is one of the most important crops for vegetable oil production, and it is observing a great development in Europe as energy crop due to its aptitude for transformation in substitutes of diesel oil, with the consequent positive impact for environment. Nevertheless, it is necessary to reduce costs. The sowing systems used are mainly based on traditional tillage practises, but it is known the viability of the rapeseed for no tillage methods (direct seeding) with similar results. Within direct seeding technique is particularly important the work of the seed row opener that affects to micro-environment of seeds during germination and emergence. The objectives of this study were to evaluate the effects of crop residue amount on water content, crop emergence and crop yield.

The experiment was set up near the city of León (Spain). The experimental plots were located at the direct drill fields of Agricultural Engineering School of the University of León (42º35' N, 5º35' W). Treatments were obtained when combining two levels of stubble amount, 900 kg/ha (30% of soil covered), 4,300 kg/ha (80% of soil covered), with two treatments on the sowing line, with or without residue on the sowing line.

Straw amount does not affect water content compared with partial removal or local accumulation of stubble. Stubble amount affects negatively to speed of emergence due probably to thermal isolation. Lower amounts of straw allow a faster emergence than larger amounts of residue. Removal of straw from the sowing line permits a faster emergence, reducing risks of plant loss before establishment. Yield components, number of pods per plants and branches per plant, was significantly lower with residue on the sowing line, however grain production of rapeseed was not affected.

Key words: Crop residue, direct seeding, rapeseed, yield.

1. Introduction

Rapeseed is one of the most important crops for vegetable oil production, and it is observing a great development in Europe as energy crop due to its aptitude for transformation in substitutes of diesel oil, with the consequent positive impact for environment. This specie has good adaptation to conditions of León (Spain) and should become a good alternative for rotation with traditional cultivations.

Nevertheless, it is necessary to reduce costs. The sowing systems used are mainly based on traditional tillage practises, but it is known the viability of the rapeseed for no tillage methods (direct seeding) with similar results. To obtain performances and acceptable qualities is necessary to handle adequate sowing techniques because germination and crop establishment stages are determinants for final yields (Sierts et al., 1987; Adamsen y Coffelt, 2004).. Within direct seeding technique is particularly important the work of the seed row opener that affects to micro-environment of seeds during germination and emergence.

Effects of direct seeding compared with conventional tillage have been widely studied under different climatic conditions and crops. However, there is a limited information about the way crop residue management affect soil and yields, especially concerning with stubble amount and its interaction with seeder controls. The percentage of soil covered by residues influences on soil organic carbon content and aggregate stability (Baldev et al., 1994). Other soil properties can be enhanced when increasing stubble amount in crops like irrigation maize (Karlen et al., 1994).

In other way, opener system of seeders influence on water availability and physical properties of the seedbed during germination (Tessier et al., 1991), and soil disturbance done by openers can affect later to water loss during final stages of growth (McLeod et al., 1992). In addition, effects of in-row residue removal have been analysed in row crops such as maize, clearing a 20 – 30 cm band on seeding line, obtaining a faster emergence (Fortin, 1993), and higher yields (Wolkowski, 2000).

Research in this way must be carried out, especially in Mediterranean climates or semiarid regions such as Spanish central plains where problems of stubble management and plant establishment have been shown on. Thus, more detailed studies are needed on these features of direct seeding.

The objectives of this study were to evaluate the effects of crop residue amount on water content, crop emergence and crop yield.

2. Materials and Methods.

The experiment was set up near the city of León (Spain). The experimental plots were located at the direct drill fields of Agricultural Engineering School of the University of León (42º35' N, 5º35' W). It was conducted in years 2006 on a medium-textured Fluvisol in a randomised complete block design with three replicates on 10 x 2,72 m plots. Mean annual precipitation of experiment site is 661.8 mm. Treatments were obtained when combining two levels of stubble amount, 900

kg/ha (30% of soil covered), 4,300 kg/ha (80% of soil covered), with two treatments on the sowing line, with or without residue on the sowing line.

Rapeseed (Brassica napus, var. oleifera) cv. Kabel was sown in April at 9.42 kg/ha after spraying 2 l/ha, 36% glyphosate. Other fertiliser or herbicide applications followed conventional broadcasting techniques used by local farmers. A 2,72 m working width disc opener drill was used.

Water content was measured at 10-20 cm depth. Water content was obtained by gravimetric method using a 100 cm^3 steel cylinder according with Blake and Hartge (1986).

Plant emergence was measured by sampling 9 meter sections of seeding lines, in May each five days. Experimental plots were hand harvested at grain maturity Yield and yield components were obtained by randomly selecting four sections of 0.8 m on seeding line in each plot. Number of productive plants per square meter, number of branches per plant, number of pods per branch and seed yield was recorded.

Analysis of variance was performed using the general linear models (GLM) procedure of the SAS statistical package. All tested treatments were considered to be fixed effects. The least significant difference (LSD) method ($P<0.05$) was used to evaluate differences between treatments when they were observed to be significant.

3. Results and Discussion

3.1. Soil water content.

Average soil water content during growing season was not significantly affected by stubble amount in spite of differences were slightly under least significant difference. These are not in agreement with results of López et al., (2005) than reported than on maize plots with higher amounts of stubble showed higher water accumulation rates.

3.2. Plant emergence.

Stubble amount influenced significantly on speed of emergence with mean values higher for lower level of stubble amount. Residue amount did not influence on total number of emerged plants.

In-row residue removal only affects significantly to the speed of emergence allowing a faster emergence, what is accorded with Kaspar et al. (1990).

3.3. Yield and yield components.

Stubble amount din not significantly affect to grain yield that varied from 3,095 kg/ha with 30% of soil covered to 2,888 kg/ha with 80% of soil covered. Residue amount did not affect to yield components.

In-row residue removal affects to the number of pods per plants and branches per plant than was significantly lower than with the residue on the sowing line. Residue clearance, despite of not being an important factor affecting yield, has affected significantly to the number of pods per plants, with a difference of approximately of 10 % higher when residue on the seeding line was not removed.

Yield of rapeseed (14% water content) varied from 3,139 kg/ha with residue on the sowing line to 2,845 kg/ha without residue on the sowing line but this differences were not significant.

Conclusions

Straw amount does not affect water content compared with partial removal or local accumulation of stubble. Stubble amount affects negatively to speed of emergence due probably to thermal isolation

Lower amounts of straw allow a faster emergence than larger amounts of residue. Removal of straw from the sowing line permits a faster emergence, reducing risks of plant loss before establishment.

Yield components, number of pods per plants and branches per plant, was significantly lower with residue on the sowing line, however grain production of rapeseed was not affected.

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