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Competition Functions of Different Canola-Based Intercropping Systems

Muhammad Tahir, Muhammad Asghar Malik, Asif Tanveer and [1]Rashid Ahmad
Department of Agronomy, [1] Department of Crop Physiology,
University of Agriculture, Faisalabad, Pakistan

Abstract: Competition functions of different intercropping systems i.e. canola, wheat gram, lentil and linseed were compared with sole cropping of canola for two consecutive years under the field conditions. Competition behaviour of component crops across different intercropping systems and planting patterns was determined in terms of relative crowding coefficient, aggressivity and competitive ratio. Relative crowding coefficient (RCC) reflected that maximum K (4.08) was obtained from canola+one row of wheat intercropping system. Aggressivity (A) values –0.03 and 0.06 indicated that wheat was the most competitive crop to canola. Similarly, competitive ratio (CR) 0.82 and 0.51 showed that among intercrops, wheat proved to be a better competitor than other intercrops when grown in association with canola.

Key words: Competition functions, canola-based intercropping systems, competition behaviour, relative crowding coefficient, aggressivity, competitive ratio

Introduction

Farmers in Pakistan are constrained by low crop productivity due to limited land resources. A possible way of increasing the productivity on small farms would be through intercropping, as it provides security against potential losses of monoculture. Moreover, there is a need for increased production of oilseeds, pulses and food grains as huge amount of foreign exchange is spent annually on the import of these commodities. The total area under canola, wheat, gram, lentil and linseed crops during 2000-2001 were 83, 20098, 2015, 71 and 20 thousand acres with total production 42, 18500, 304, 19 and 5 thousand tons, respectively (Anonymous, 2002). The area under canola and pulses is limited and can not be increased due to competition with wheat. An alternative to increase the production of these crops could be through intercropping. Therefore, intercropping is an effective tool in increasing the production of farm per unit area per unit time. Substantial advantages in yield from intercropping compared with sole cropping occur from complementary effect of different resources when grown together (Willey, 1979).

Competition behaviour of component crops across different intercropping systems and planting patterns are determined in terms of relative crowding coefficient (RCC), aggressivity (A) and competitive ratio (CR). Relative crowding coefficient (RCC) plays an important role in determining the competition effects and advantages of intercropping. According to Willey (1979), in an intercropping system each crop has its own RCC (K). The component crop with higher K value is the dominant one and that with lower K is dominated. To determine if there is yield advantage of intercropping, the product of the coefficients of both the components crops is formed that is usually designated as K. If the product of RCC of two species is equal, less or greater than 1, it means the intercropping system has no advantage, disadvantage or advantage, respectively.

Aggressivity (A) value is an important tool to determine the competitive ability of a crop when grown in association with another crop. An aggressivity value of zero indicates that component crops are equally competitive. If both crops will have the same numerical value, the sign of the dominant species will be positive and that of the dominated negative. Greater the numerical value, bigger the differences in competitive abilities and higher the differences between actual and expected yields. Competitive ratio (CR) is an important way to know the degree with which one crop competes with the other.

Keeping in view the importance of intercropping present study was, therefore, undertaken to determine the competition functions of some canola-based intercropping systems under agro-climatic conditions of Faisalabad.

Materials and Methods

The present study was conducted at the Agronomic Research Area, University of Agriculture, Faisalabad during winter season of 1999-2000 and repeated in the same season in 2000-2001.

The experiment was laid out in a randomized complete block design (RCBD) with three replications. Intercropping systems were: no intercropping (sole canola), canola+one row of wheat, canola+two rows of

wheat, canola+one row of gram, canola+two rows of gram, canola+one row of lentil, canola+two rows of lentil, canola+one row of linseed and canola+two rows of linseed. Plot size was 2.4x5.1 m^2. For the monoculture of gram, lentil and linseed, the net plot sizes were also 2.4x5.1 m^2 but for wheat it was 2.5x5.1 m^2. Seed bed preparation was uniform for both sole cropping and intercropping. The same varieties of canola (Hyola-401), wheat (Inqlab-91), gram (Bittal-98), lentil (Masoor-93) and linseed (Chandni) were used during both the years. Canola was sown on 14th October with a single row hand drill in 60 cm spaced paired row strips (60/20 cm) during 1999 and 2000. Intercrops were sown on 23rd October during both the years alongwith monoculture of wheat, gram, lentil and linseed. All the crops except wheat thinned twice to maintain optimum plant population. A basal dose of 90 kg N and 60 kg P_2O_5 ha^{-1} was applied in all the treatments. Three irrigations were applied at different growth stages of canola. All other agronomic practices were kept normal and uniform for all the treatments. Both sole and intercrops were harvested manually and tied into separate bundles. The sun dried crops were threshed manually. Relative crowding coefficient (K) was calculated by the formula proposed by Dewit (1960). Aggressivity value was calculated by the formula given by McGilchrist (1965). Competitive ratio (CR) was calculated by the formula proposed by Willey *et al.* (1980).

Results and Discussion

Relative crowding coefficient (RCC): In all the treatments, canola appeared to be highly dominant as it had higher values of K than the intercrops in different intercropping systems (Table 1). It can be inferred that the intercropped canola utilized the resources more competitively than wheat, gram, lentil and linseed which appeared to be dominated. As products (K) of coefficients of the component crops were greater than one, there were yield advantage in all the intercropping systems. The maximum canola yield (4.08) advantage was obtained from canola+one row of wheat.

Maize soybean (El-Edward *et al.*, 1985), wheat-Indian mustard (Singh and Gupta, 1993) as well as wheat-methra and wheat-gram (Shahid and Saeed, 1997) have been reported to give yield advantages over the respective monoculture on the basis of RCC.

Aggressivity (A): The component crops did not compete equally (Table 2). Regardless of treatments, positive sign for A values of canola indicated the dominant behaviour of canola over all intercrops which had negative A values. Aggressivity value was the minimum for canola + one row of wheat (-0.03) and canola + two rows of wheat (-0.06), which indicated that wheat was the most competitive crop to canola. Gram (-0.12) and lentil (-0.11) proved to be less competitive with canola as there was a little difference

Table 1: Relative crowding coefficient as affected by different canola-based intercropping systems

	Intercropping system											
	Canola + Wheat			Canola + Gram			Canola + Lentil			Canola + Linseed		
Treatments	K_C	K_W	K	K_C	K_G	K	K_C	K_L	K	K_C	K_I	K
Canola + one row of intercrop	3.61	1.13	4.08	5.76	0.20	1.15	5.14	0.29	1.49	4.45	0.50	2.23
Canola + two rows of intercrop	4.01	0.70	2.81	16.89	0.06	1.01	13.55	0.11	1.49	6.66	0.27	1.80

Each value is the mean of 2 year data
K_C= Coefficient of canola, K_L= Coefficient of lentil, K_W= Coefficient of wheat,
K_I= Coefficient of Iinseed, K_G= Coefficient of gram, K= Product of coefficient

Table 2: Aggressivity values for the component crops as affected by different canola-based intercropping systems

	Intercropping system							
	Canola + Wheat		Canola + Gram		Canola + Lentil		Canola + Linseed	
Treatments	A_C	A_W	A_C	A_G	A_C	A_L	A_C	A_I
Canola + one row of intercrop	+0.03	-0.03	+0.12	-0.12	+0.11	-0.11	+0.8	-0.8
Canola + two rows of intercrop	+0.06	-0.06	+0.15	-0.15	+0.14	-0.14	+0.11	-0.11

Each value is the mean of 2 year data
A_C= Aggressivity of canola, A_L= Aggressivity of lentil, A_W= Aggressivity of wheat,
A_I= Aggressivity of Iinseed, A_G= Aggressivity of gram

Table 3: Competitive ratio (CR) as affected by different canola-based intercropping systems

	Intercropping system							
	Canola + Wheat		Canola + Gram		Canola + Lentil		Canola + Linseed	
Treatments	CR_C	CR_W	CR_C	CR_G	CR_C	CR_L	CR_C	CR_I
Canola + one row of intercrop	1.22	0.82	5.11	0.20	3.56	0.28	2.24	0.45
Canola + two rows of intercrop	1.95	0.51	17.50	0.06	9.31	0.11	4.14	0.24

Each value is the mean of 2 year data
CR_C= Competitive ratio of canola, CR_L = Competitive ratio of lentil, CR_W = Competitive ratio of wheat,
CR_I = Competitive ratio of linseed, CR_G = Competitive ratio of gram

among their aggressivity values. These results concur with previous findings, according to which rapeseed was dominant having positive A value when grown in association with wheat (Ali, 1999) and linseed (Shahid and Saeed, 1997).

Competitive ratio (CR): Higher CR values for canola than those for wheat, gram lentil and linseed indicated that in all intercropping systems, canola was more competitive than wheat, gram, lentil and linseed when grown in association with each other (Table 3). The competitive ratio was the highest for wheat (0.82) followed by linseed (0.45). These results suggest that among intercrops, wheat proved to be a better competitor than other intercrops when grown in association with canola. Ali (1999) also reported that wheat was better competitor than other crops when sown in association with canola.

It is concluded that canola was the dominant crop in each intercropping system under study. Among intercrops, wheat was more competitive followed by linseed than gram and lentil.

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