Optimizing spatial arrangement for durum wheat (*Triticum durum* Desf.) and subclover (*Trifolium subterraneum* L.) intercropping system

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Aim: To find a suitable spatial arrangement for the subclover living mulch-durum wheat system in order to provide a high cereal grain yield and a sufficient subclover reseeding after wheat harvesting

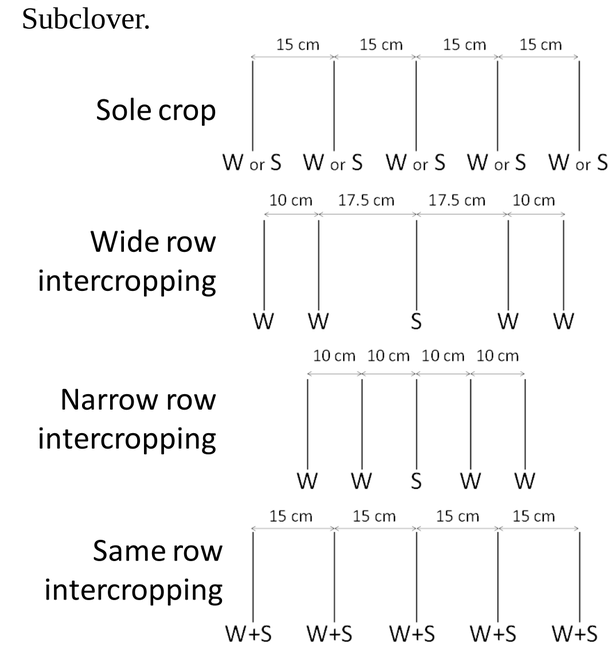
MATERIALS & METHODS

The study was carried out at the experimental farm of Tuscia University from 2011 to 2013. Field experiments included:

(i) 5 cropping systems including the monoculture of durum wheat and subclover and three different durum wheat/subclover intercropping spatial arrangements (Fig. 1);
(ii) 2 nitrogen fertilization levels (0 and 100 kg ha^{-1} of N, hereafter called N0 and N100, respectively);
(iii) 2 weed managements [weed-free (WF) and weedy (We)].

The wheat planting density was 400 seeds m^{-2} regardless the cropping system, while the subclover planting density was 600 seeds m^{-2} in pure stand, and 300 seeds m^{-2} in the intercropped treatments.

Figure 1. Layout of wheat-subclover intercropping systems and monocultures. W = durum wheat; S = Subclover.



RESULTS & DISCUSSION

The total productivity of the intercropped systems was always higher than pure crops (RBT > 1) thus resulting in higher total production per unit area and greater land-use efficiency (Table 1). The narrow row intercropping showed a wheat grain yield similar to the sole wheat crop (Table 2). Wheat aggressivity was highest in same row intercropping and lowest in wide row intercropping.

Figure 2. Cropping systems adopted in the experiment at durum wheat filling stage


Same row intercropping


Wide row intercropping

Table 1. Relative biomass total (RBT) and wheat aggressivity (Ad) at wheat physiological maturity for the planting pattern and fertilization level treatments. Values belonging to the same characteristic and treatment without common letters are statistically different according to LSD (0.05), in columns for planting pattern (lower case letters) and in rows for nitrogen fertilization (upper case letters).

	Relative Biomass Total (RBT)				Aggressivity of wheat (Ad)			
	0 kg N ha^{-1}		100 kg N ha^{-1}		0 kg N ha^{-1}		100 kg N ha^{-1}	
Wide row intercropping	1.51	aA	1.25	aB	0.14	cB	0.22	bA
Narrow row intercropping	1.40	bA	1.19	aB	0.29	bB	0.34	aA
Same row intercropping	1.06	cA	1.01	bA	0.36	aA	0.35	aA

Table 2. The main effect of planting pattern, nitrogen and weed management on the yield and yield characteristics of wheat. Values belonging to the same variable and treatment without common letters are statistically different according to LSD (0.05).

	Yield (t ha^{-1} of DM)		Straw (t ha^{-1} of DM)	
Wide rows intercropping	3.51	b	6.25	b
Narrow rows intercropping	3.91	a	7.08	a
Same row intercropping	3.59	b	6.65	b
Sole wheat	4.14	a	7.22	a
0 kg N ha^{-1}	2.99	b	5.67	b
100 kg N ha^{-1}	4.59	a	7.93	a
Weed free	4.13	a	7.36	a
Weedy	3.45	b	6.24	b

The subclover living mulch showed a progressive reduction of the aboveground biomass and seed production compared to the sole subclover due to its increased proximity with wheat (Table 3). However, in the autumn of the second year, the number of regenerated subclover seedlings was suitable for regenerating a new ground cover regardless spatial arrangement .


Narrow row intercropping


Sole durum wheat

Table 3. Aboveground biomass, seeds of subclover at wheat physiological maturity, and number of regenerated seedlings of subclover in autumn after wheat harvesting for the spacing treatments and the fertilization levels. Values belonging to the same characteristic and treatment without common letters are statistically different according to LSD (0.05), in columns for planting pattern (lower case letters) and in rows for weed management and nitrogen fertilization (upper case letters).

	Aboveground biomass (g m^{-2} of DM)				Seed number (seeds m^{-2})				Regeneration (seedlings m^{-2})			
	0 kg N ha^{-1}		100 kg N ha^{-1}		0 kg N ha^{-1}		100 kg N ha^{-1}		0 kg N ha^{-1}		100 kg N ha^{-1}	
Wide row intercropping	234	bA	127	bB	1228	bA	819	bB	847	bA	541	bB
Narrow row intercropping	172	cA	110	bcB	991	bA	612	bcB	689	cA	402	cB
Same row intercropping	86	dA	69	cA	585	cA	436	cA	355	dA	291	dA
Sole subclover	409	aA	411	aA	3222	aA	3382	aA	2103	aA	1988	aA

CONCLUSION

This study shows that when subclover is used as living mulch for durum wheat, a moderate separation of the two species, such as that obtained when the wheat was sown in rows 10 cm apart from the subclover rows, seems to be the best strategy for maximizing grain yield and ensuring a satisfactory subclover reseeding.