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Title

Effects of application of different green manure sources in rotation with wheat on wheat yield and soil properties

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Introduction

Mineral and organic fertilizers have an important role in improving of soil fertility for crop production. Mixing mineral manure with different forms of organic materials, such as legumes in rotation with crops, is a good strategy for improving soil fertility, increasing nutrients in the soil and increasing plant survival rates (1). Green manure and animal waste increase absorption of non-solution phosphorus in soil while also increasing phosphorus absorption from phosphorus fertilizer. Because green manure alone could not provide enough essential nutrients for maximizing crop yield, the best strategy is using green manure with a blend of chemical fertilizers. This mix reduces the application of mineral fertilizer and decreases environment pollution (2). One study has reported that the use of legume green manures had a significant effect on wheat yield, indicating a positive effect on soil structure (3). Another study reported that yields of wheat increased 500-1400 kg ha⁻¹ with increasing N ranging from 81-162 kg ha⁻¹ compared with the control (4). Our experiment was undertaken with the aim of studying the effect of green manure application on soil properties, wheat yield and mineral fertilizers application rates in the Sistan-Iran region.

Material and methods

This experiment was done as split plots based on a randomized complete block design with 3 replications in two years, 2006 and 2007, using Hamoon wheat cultivar. The main plots were N, P and K fertilizers, including 0, 50 and 100 percent and subplots were different sources of green manures including 1-control, 2-clover, 3-bean and 4-barley fertilizer. The size of each plot was 12 m². In the first year green manures were planted in each plot and the third cutting of clover and barley plants in each plot were added to the soil of the plot. The green manure of bean increased after green pod appearance to soil. Before sowing the wheat in the second year and before the application of N, P and K manures, soil properties were determined at a depth of 0-30. In the second year wheat was sown and N, P and K applied to the soil. Treatment of NPK 100% was 350 (kg ha⁻¹) Urea, 120 (kg ha⁻¹) Super Phosphate Triple and 200 (kg ha⁻¹) Potassium Sulfate. Finally, the yield and components of wheat yield in each plot were determined.

Results and discussion

The amounts of dry matters added to soil by application of barley, clover and bean green manures were 4824, 1550 and 3532 (kg ha⁻¹), respectively. Results showed that the amount of soil organic carbon, phosphorus and zinc were affected by green manures. Comparison of the means showed barley green manure increased soil organic carbon, phosphorus and zinc the most (Table1), likely because it led to a greater increase in dry matter in the soil than other green manures. Although barley manure increased available potassium in the soil, there were no significant differences among other treatments. Results of green manure plots showed none of the treatments had a significant effect on bulk density or the amount of wheat root in the depth zone of 0-20 cm. Fertilizers of N, P and K increased wheat root growth with applications of treatments 50% (NPK) and 100% (NPK) increasing more than the control (data not shown).

Mineral manures significantly affected the number of spikes (m²) and number of seeds per spike in the 5% level and on the 1000 seed weight. Effects to biologic yield and seed yield were significant at the 1% level. The highest yield, 5312 kg ha⁻¹, was related to 100% N, P and K treatments, and was significantly different from the 50% (NPK) yield of 4859 kg ha⁻¹ and the control yield of 3856 kg ha⁻¹. The difference between the 50% NPK and control was also significant (Table 2). Given these results, we recognized the application of green manure increases dry matter in the soil, soil O.C% and nutrient availability. Barley green manure,

although it increased soil O.C%, phosphorus and zinc of the soil, was not an effective factor for yield increasing in wheat because it could not effect bulk density due to the lower concentration of dry matter in the soil, and thus could not increase root growth. The most limiting factor of growth in Sistan soils is mechanical resistance confronting root growth (5). Green manure application could not remove this problem.

Table 1: Comparison mean of green manures before planting on soil O.C%, phosphorus and potassium

Treatments	O.C%	Available P (mg/kg)	Available K (mg/kg)	Available Zn (mg/kg)
Control	0.39b	5.7b	146a	0.25b
Clover	0.412b	6.3b	137a	0.39ab
Bean	0.43ab	4.9b	133a	0.33b
Barley	0.49a	7.5a	172a	0.56a

Values of each column with the same letter are not significantly different ($p < 0.05$) by the LSD test

Table 2: comparison means of mineral manure effects on yield and yield components

Treatments	Spike number in m ²	1000 grain weight	Grain number per spike	Biological yield	Grain yield (kg ha ⁻¹)
Without NPK application	485b	29.2b	45.2b	8652b	3856c
%50 NPK application	532ab	38.4a	46b	11979a	4859b
%100 NPK application	553a	36.8a	50.3a	12878a	5312a

Values of each column with the same letter are not significantly different ($p < 0.05$) by the LSD test

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