Review Paper

Possibility of Allelopathic and Residues Effects of The Rotated Crops on Productivity, Chemical Composition, Nitrogen Utilization of Wheat (*Triticum aestivum*) and Soil Fertility.

Moshira A. El-Shamy[1] and Kholoud A. El-Naqma[2]

[1] crop intensification Res. Department, Field Crops Res. Institute, A. R. C, Giza, Egypt.

[2] Soils, Water and Environment Res. Institute A. R. C, Giza, Egypt.

Abstract

A field study was carried out at Sakha Agricultural Research Station farm , ARC, Kafr El-Sheikh governorate, Egypt, during two successive seasons of 2016/2017and 2017/2018 to evaluate the possibility of allelopathic effects of the rotated crops on productivity, chemical composition, N utilization of wheat and soil fertility.

The local wheat cultivar (Sids 12) was sown after three crops (fahl berseem) after rice, (Drawa) after rice and Fallow after rice as preceded crops. A split plot design with three replications was used. The main plots were assigned with three previous crops , The sub plots were assigned by three nitrogen fertilizer rates (0, 35 and 70 kg N fed^{-1}) the results showed that fahl berseem roots and residues in the clover (berseem)-wheat rotation secreted biologically active chemical compounds which have a positive effect on growth and development of wheat. The preceding clover (fahl berseem) wheat rotation appeared to be promising for wheat productivity, N, P, K concentrations, N-uptake, N utilization, protein content of wheat grain and straw, availability of N, P and K after wheat harvest compared with fallow after rice, green maize (drawa-wheat rotation). The interaction between the preceded crops and N fertilizer rates was significantly for all the studied traits. The highest performance of wheat traits were observed when wheat was grown after fahl berseem and fertilized with 70 kg N.fed^{-1}. While the lowest performance was obtained following cereal crops rice (fallow) and the lowest N level in both seasons. Treatment of fahl berseem with nitrogen fertilizer (70 kg N.fed^{-1}) had given a best values from grain yield with relative increments of (37.54%) compared with preceding rice-wheat rotation and (23.26%) compared with rice-drawa rotation.

Keywords: Allelopathy, Preceded crops, N rates, rice , drawa, fahl beresem, wheat.

1. INTERODUCTION

Rice-wheat cropping system is one of the most important cropping systems in Egypt. Both rice and wheat crop are highly nutrient exhaustive and therefore, causing deficiency of several nutrients [28].

The hypothesis was presumed that harvesting rice in 5^{th} -10^{th} day period of August thus improving both, yield and quality. On the other hand, there is a long period between preceding crops (summer crops harvesting) such as rice and (winter crops) such as wheat crop sowing which causes fallow the land without agriculture So in this period we can sow legume crop as a forage crop to animals before sowing wheat crop which improve soil properties, growth and development of wheat [17] and consider additional revenue to farmer. Fahl barseem (Egyption clover) had be sown in the end of august month after rice crop to produce approximetly 20 ton fresh forage.fed^{-1} (~ 9 ton dry forage fed^{-1}) which provides farmers with (~ 9 thousands EL) in 75 days only. Also, Drawa had be sown in the same time after rice crop to produce 4.2-7.5 ton green maize.fed^{-1} with low cost.

Forage legumes, such as Berseem (Egyption clover), were grown on a large number of acres. They differ markedly from grasses, cereals and other non-legume crops because much of the nitrogen they require is produced through fixation of atmospheric nitrogen by bacteria in nodules on their roots. Soil organic reserves declined due to cereal cropping and frequent fallowing. This resulted in an increase in green manure, thus an increase in the importance of legumes growing concerns about declining organic matter, soil fertility and rising energy and nitrogen fertilizer costs have led to renewed interest in legumes. Thus, the role of legumes as a nitrogen supplier in the rotation and as a builder of soil organic matter will likely gain importance in the future, [7].

Fahl berseem can fix 45.36 to 90.72 kg. N/A or more. It establishes well with an oat nurse crop, making it an excellent cover for small grain, corn, soybean rotations in the Midwest. [8].

Allelopathy is an interference mechanism, in which living or dead plant materials release allelochemicals exerting an effect on the associatd plants, and can play an important role in natural ecosystems [12].

Root exudate is one of the ways for plant communication to the neighboring plant and adjoining of microorganisms present in the rhizosphere of the root. The chemicals ingredients of the root exudates are specific to a particular plant species and also depend on the nearby biotic and abiotic environment. Asurvey of the literature exposes an extensive range of compounds exuding from intact and healthy roots; these include sugars, peptides, amino acids, enzymes, vitamins, organic acids, nucleotides, fungal stimulators, inhibitors and attractants, eelworm hatching and attracting factors and many miscellaneous compounds. Organic acids, sugars, amino acids, lipids, coumarins, flavonoids, proteins, enzymes, aliphatics and aromatics are examples of the primary substances found within rhizosphere of the root. Among them, the organic acids have received considerable attention due to their role in providing substrates for microbial metabolism and for serving as intermediates for biogeochemical reactions in soil [24] and [6].

Root exudation is an element of the rhizodeposition process, which is a major source of soil organic carbon released by plant roots [15]and [23]. Upon assembling a challenge, roots typically respond by secreting certain small molecules and proteins [32] and [33]. Root secretions may play both positive and negative communication in the rhizosphere. The positive communication includes symbiotic associations with beneficial microbes, such as *mycorrhizae, rhizobia* and plant growth promoting *rhizobacteria* (PGPR). Negative interactions include association with parasitic plants, pathogenic microbes and invertebrate herbivores. The rhizospheric bacteria are responsible for the elimination of the contaminants while the roots are responsible for providing nutrients (root exudates) used by the microorganisms to proliferate [4].

The objective of this experiment was to determine the effect of preceding crop and nitrogen fertilizer rate on productivity, chemical composition, soil fertility and N utilization of wheat.

2. MATERIALS AND METHODS

Afield experiment was carried out in a clayey textured soil (Clayey, Smectitic, Superactive, Mesic, Typic) located at Sakha Agricultural Research Station farm, Kafr El-Sheikh Governorate, Egypt (30^{o} 56 N latitude and 31^{o} 05 E longitude) to investigate the effect of cereal crops (summer crops) and legume (winter crop)-wheat rotation. one summer crop (rice) and one winter crop (wheat) was sown and two forage crops (fahl berseem and drawa) between rice and wheat were sown . The first experiment was initiated in 2016 summer season and terminated in 2016-2017 the winter season whereas; initiation and termination of the second experiments were summer and winter seasons of 2017and 2018, respectively. some physical and chemical properties were determined according to [16] and [5]. Some soil chemical and physical properties (Table 1).

Table 1. Some chemical and physical properties of the experimental soil (0-60 cm).

Soil fert.characteristics	1st	2nd
Partical size distribert		
Sandy%	18	18
Silty%	30.8	31.3
Clay%	51.2	52.7
Texture	Clayey	Clayey
pH1:2.5	8.08	7.96
EC Soil paste Ex.Ds.m^{-1}	2.92	2.76
Cation soluble.meq.L^{-1}		
Ca^{++}	9.3	8.5
Mg^{++}	8.5	7.7
Na^{+}	10.1	9.8
K^{+}	1.7	1.7
Anion soluble meq. L^{-1}		
Co^{-3}	-	-
Hco^{-3}	2.4	2.1
cl^{-}	14.5	13.7
So^{-4}	13	12
Available N mg.kg^{-1} after rice	34	35.2
Available N mg.kg^{-1} after Drawa	36.2	37.9
Available N mg.kg^{-1} after fahl berseem	40	42
Available P mg.kg^{-1} after rice	16	17
Available P mg.kg^{-1} after drawa	17.2	18.5
Available P mg.kg^{-1} after fahl berseem	25	26.7
Available K mg.kg^{-1} after rice	255	269
Available K mg.kg^{-1} after drawa	267	292
Available K mg.kg^{-1} after berseem	423	432
OM% after rice	1.56	1.61
OM% after drawa	1.67	1.78
OM% after fahl berseem	1.82	1.95

Harvesting date of the previous crops at two seasons :

- Rice 20 August 2016 in 1st season and 20 August in 2nd season.
- Berseem fahl was sown in 25 august 2016 in 1st season and 22 August 2017 in 2nd season, and harvested in 20 Nov.

- Drawa was sown in 25 august 2016 in 1st season and 22 August 2017 in 2nd season, and harvested in 20 Nov.
- Wheat 25 Nov 2016 to 30 May 2017 in 1st season and 20 Nov 2017 to 25 May 2018 in 2nd season.

A split plot design was used with three replicates. The preceding crops (rice, drawa and fahl berseem) comprised the main plots and three nitrogen fertilizer levels (N1=0, N2=35 and N3=70 kg $N.fed^{-1}$.) were tried in the sub-plots in the form of urea (46.5%) in two equal doses, the first dose was at Mohayah irrigation (30 days after sowing); while the second addition was at the second irrigation after Mohayah irrigation directly (30 days after the first addition). Phosphorus fertilizer was applied during soil preparation in the form of Calcium supr phosphate (15.5% P_2O_5) at a rate 15 kg $P_2O_5.fed^{-1}$. Potassium at the rate of 24 kg $K_2O.fed^{-1}$ in the form of potassium sulphate (48% K_2O).

. wheat (C.V. Sids 12) was sown following the three preceding crops as a relay crop.

Plot was 24 m^2 in area (4 m long and 6 m in width). The preceding crop residues on plots were shredded by tillage that consisted of disking twice 10-15 cm deep before planting wheat. At the second year, wheat was planted fallowing preceding crops with arrow spacing of 15 cm and a seeding rate 55 kg $grains.fed^{-1}$

At harvest a 1.00 m^2 portion at the center of each wheat sub plot was sampled. From these samples total dry matter and grain weight were determined by drying the sampled plants at 70°C for 72h. The harvest index and yield components (grain yield, spike number /m^2, spike seed number and 1000 grain weight) were measured. N utilization rate was calculated according to the following equation N utili. = N uptake for treatment - N uptake for control / N applied for treatment [11].

Soil sample were taken after harvesting to Determine some available elements. Available nitrogen of the soil was extracted by 1N potassium chloride and determined by Kjleldhl method [16], phosphorus was extracted by 0.5N sodium bicarbonate and calorimetrically measured by spectrophotometer [16]. Available potassium was extracted by 1N ammonium acetate and measured by flame photometer [16]. Grain and straw samples oven dried 70C° and ground thoroughly, wet digested using sulphoric and perchloric acids mixture, total nitrogen , total phosphorus , total potassium were determined according to [16].

The analysis of variance was carried out for each character in each season as out lined by [13]. The differences between the means of different treatment were tested using (LSD) at 5% level of probability were used to compare between treatments means.

3. RESULTS AND DISCUSSIONS

Table (2): Plant height (cm), spike length (cm) and number of spike/m², of wheat as affected by the remnants of the preceding crops, mineral nitrogen fertilizer levels during 2016/2017 and 2017/2018 seasons.

Treatments	Plant height (cm)		spike length (cm)		number of spike/m²	
	1st	2nd	1st	2nd	1st	2nd
A-preceding crops						
Rice (fallow)	85.7	87.5	10.0	10.1	332.3	330.4
Drawa	86.3	89.6	10.5	10.5	351.5	354.0
Fahl Berseem	91.5	95.4	10.6	10.9	383.2	385.1
L.S.D at 0.05	**1.582**	**1.712**	**0.208**	**0.326**	**8.330**	**7.7641**
F.T.	**	**	**	**	**	**
B- N-fertilization levels						
Control	80.9	84.2	9.3	9.4	346.4	348.0
35	85.5	87.8	10.5	10.7	355.8	357.7
70	97	100.6	11.3	11.4	364.9	363.8
L.S.D at 0.05	**2.921**	**3.165**	**-**	**-**	**-**	**-**
F.T.	**	**	**NS**	**NS**	**NS**	**NS**

Data presented in Table 2 show that, wheat cultivated after fahl berseem had the highest values of plant height (91.5 and 95.4 cm), spike length (10.6 and 10.9cm) and number of spikes/m² (383.2 and 385.1) in the first and second season, respectively.

On the other hand, the lowest values of the mentioned traits were recorded with wheat after rice as a previous crop in both seasons.

In respect to nitrogen levels the highest values of the plant height (97 and 100.6 cm), spike length (11.3 and 11.4 cm) and number of spikes/m² (364.9 and 363.8) was obtained with 70 kg N fed^{-1} in the first and second season, respectively. On the other hand the lowest values were recorded with the control treatment (without N fertilization).

Table (3): Plant height (cm), spike length (cm) and number of spike/m^2, of wheat as affected by the interaction between remnants of the preceding crops, mineral nitrogen fertilizer levels during 2016/2017 and 2017/ 2018 seasons.

Treatments		Plant height (cm)		spike length (cm)		number of spike/m^2	
		1st	2nd	1st	2nd	1st	2nd
Rice(fallow)	Zero	78.7	80.8	9.1	9.6	321.9	365.3
	35	79.8	84.7	9.3	9.7	326.3	376.9
	70	84.3	85.4	9.5	9.9	343.6	391.8
Drawa	Zero	85.0	87.1	10.4	10.4	348.5	378.5
	35	85.0	87.2	10.2	10.9	351.9	382.2
	70	86.5	90.9	11.2	11.4	359.2	396.3
Fahl Berseem	Zero	93.3	96.4	11.5	11.8	373.6	385.6
	35	94.0	97.0	11.8	12	381.8	390
	70	103.6	108.3	11.8	12.4	394.3	399.9
L.S.D at 0.05		2.921	3.165	-	-	-	-
F.T		**	**	NS	NS	NS	NS

The interaction between the previous crops and nitrogen fertilizer levels show that after fahl berseem and 70 Kg N had the highest plant height values (103.6 and 108.3 cm) in the first and second season, respectively. On the other hand, the lowest values of the mentioned traits were recorded with wheat after rice as a previous crop (84.3 and 85.4cm) in the first and second season.

These results may be due to improve available N and other minerals in soil after grown legumes plants which allow to uptake by root plants which effect on highest plant compared with cereal residuals which have wider C:N ratio leading to immobilization of soil N.

Also., data showed that no significant differences were recorded in spike length and spike number/m^2 due to the interaction in both season.

These results agree with [37] who found that plant height, spike length, number of spike/m^2 did not affected by the preceding crops under nitrogen fertilizer levels.

Table (4): number of grains/*spike*, weight of. grains/spike (gm) and weight of 100 grain (gm), of wheat as affected by the remnants of the preceding crops or previous crops, mineral nitrogen fertilizer levels during 2016/2017 and 2017/2018 seasons.

Treatments	number of grains/*spike*		Weight of grains/spike(gm)		weight of 100 grain (gm)	
	1st	2nd	1st	2nd	1st	2nd
A-preceding crops						
Rice (fallow)	38.1	37.9	2.4	2.3	4.7	4.6
Drawa	42.5	43.7	4.6	4.7	4.9	5.0
Fahl Berseem	43.3	45.1	5.3	5.7	4.9	5.1
L.S.D at 0.05	**0.927**	**0.837**	**0.214**	**0.219**	**-**	**0.162**
F.T.	**	**	**	**	**NS**	**
B- N-fertilization levels						
Control	39.0	45.1	3.5	3.6	4.4	4.5
35	41.0	43.7	4.1	4.2	5.0	5.0
70	43.9	37.9	4.8	4.9	5.1	5.2
L.S.D at 0.05	**0.927**	**0.837**	**0.046**	**0.219**	**0.186**	**0.162**
F.T.	**	**	**	**	**	**

Data presented in Table 4 show that, wheat cultivated after fahl berseem had the highest values of number of grains/*spike* (43.3 and 45.1), Weight of grains/spike (5.3 and 5.7 gm) in the first and second season, respectively and weight of 100 grain (5.1gm) in the second season only.

On the other hand, the lowest values of the mentioned traits were recorded with wheat after rice as a previous crop in both seasons.

In respect to nitrogen levels the highest values of the grains/*spike* (43.981 and 37.998), Weight of grains/spike (4.8 and 4.9 gm) and weight of 100 grain (5.1 and 5.2 gm) was obtained with 70 kg N fed^{-1} in the first and second season, respectively. On the other hand the lowest values were recorded with the control treatment (without N fertilization).

Table (5): number of grains/s*pike*, weight of. grains/spike (gm) and weight of 100 grain (gm), of wheat as affected by the interaction between remnants of the preceding crops, mineral nitrogen fertilizer levels during 2016/2017 and 2017/2018 seasons.

Treatments		number of grains/*spike*		Weight of grains/spike(gm)		weight of 100 grain (gm)	
		1st	2nd	1st	2nd	1st	2nd
Rice(fallow)	Zero	34.6	34.4	2.2	2.1	4.2	4.7
	35	38.3	38.3	2.5	2.5	4.4	4.7
	70	41.2	41.1	2.7	2.5	4.5	4.8
Drawa	Zero	41.3	41.9	3.7	3.9	4.9	4.8
	35	41.4	42.2	4.5	4.6	5.0	4.9
	70	42.6	43.1	4.6	4.9	5.0	5.1
Fahl Berseem	Zero	44.2	44.8	5.3	5.6	5.1	5.2
	35	46.2	46.0	5.7	5.3	5.2	5.3
	70	42.6	48.1	6.2	6.6	5.2	5.4
L.S.D at 0.05		1.714	-	0.397	0.405	-	-
F.T		*	Ns	**	**	Ns	Ns

The interaction between the previous crops and nitrogen fertilizer levels show that after fahl berseem and 70 Kg N had the highest number of grains/spike values (42.6 cm) and in first season only and Weight of grains/spike (6.2 and 6.6 gm) in the first and second season, respectively and no significant differences were recorded in weight of 100 grain (gm) due to the interaction.

This result may be interpreted according to C/N ratio in soil because the microorganisms in soil such as bacteria need to nitrogen to live and analyzes the residual of preceding crops such as straw, this will reduce the available nitrogen which effect on growth yield, reduce their values.

These results agree with [37] and [17], studied the effect of preceding crops and nutrient management on growth and productivity of wheat. They indicated that growing legume crop as the preceding crop resulted significant higher parameters of wheat than preceding maize crop.

Table (6): grain yield ardb.fed^{-1} and straw yield ton.fed^{-1} of wheat as affected by the remnants of the preceding crops, mineral nitrogen fertilizer levels during 2016/2017 and 2017/2018 seasons.

Treatments	Grain yield ardb.fed^{-1}		Straw yield ton.fed^{-1}	
	1st	2nd	1st	2nd
A-preceding crops				
Rice (Fallow)	17.02	16.94	1.98	2.156
Drawa	19.65	20.61	2.75	3.146
Fahl Berseem	22.86	24.17	3.25	4.388
L.S.D at 0.05	**6.46**	**7.58**	**0.02**	**0.30**
F.T.	**	**	**	**
B- N-fertilization level				
Control	18.71	19.18	2.471	2.858
35	19.44	20.20	2.67	3.256
70	21.39	22.35	2.84	3.576
L.S.D at 0.05	**4.89**	**2.21**	**0.02**	**0.18**
F.T.	**	**	**	**

- Ardb=150 kg

Generally, data in Table 6 show the values of grain and straw yields in both seasons as affected by preceding crops and mineral nitrogen fertilizer levels. The data indicated that preceding crops had a significant effect of grain and straw yields. Treatment of preceding fahl berseem had given abest values from yield (22.86 and 24.17) ardb.fed^{-1} in the first and second season respectively compared with the values of preceding drawa treatments(19.65 and 20.61).

The effect of recommended dose (70 kg N.fed^{-1}) level under those of fahl berseem on grain and straw yields were highly significant. Treatment of preceding fahl berseem had given a best values from yield (21.39 and 22.35) and a highest values from straw (2.84 and 3.576) in first and second season respectively, where the control treatment had the lowest values.

Table 7: grain yield ardb.fed^{-1} and straw yield ton.fed^{-1} of wheat as affected by the interaction between remnants of the (preceding crops) , mineral nitrogen fertilizer levels during 2016 / 2017-and 2017 / 2018 seasons.

Treatments		Grain yield ardb.fed^{-1}		Straw yield ton.fed^{-1}	
		1st	2nd	1st	2nd
Rice(fallow)	Zero	15.60	15.4	1.69	1.66
	35	17.09	17.00	2.04	2.20
	70	18.38	18.43	2.22	2.51
Drawa	Zero	19.10	19.90	2.73	2.87
	35	19.36	19.98	2.75	3.05
	70	20.51	21.97	2.77	3.52
Fahl Berseem	Zero	21.45	22.26	2.99	4.04
	35	21.86	23.62	3.22	4.42
	70	25.28	26.64	3.54	4.7
L.S.D at 0.05		8.4766	3.8354	0.045	-
F.T.		**	**	**	N.S

The data obtained from Table 7 show that a significant effect of the interaction between preceding crops and N fertilizers levels on grain yield on both seasons, while a significant effect on straw yield in the first season only but no significant effect on straw yield on 2nd season. Treatment of fahl berseem with recommended dose from nitrogen fertilizer (70 kg.N fed^{-1}) had given a best values from grain yield ardb.fed-1 (25.28 and 26.64) ardb.fed^{-1} with relative increments of (37.54%) compared with preceding rice-wheat rotation and (23.26%) compared with rice-drawa rotation.

These results may be due to the increase in the activity of antioxidants in response to stresses has been previously reported, which both biotic and a biotic stresses are known to induce plants to produce reactive oxygen species [9]. The increase activity of antioxidant enzymes is perhaps a secondary effect of allelochemicals [25]. Species of preceding crops significantly affected wheat yield such as mungbean might help to maximize wheat yield in a crop rotation system [20] wheat grain yield was greater following legumes crop than other preceding crops. The benefits of the legume crops is related to both nitrogen and the effects of compex rotation procedures. The lowest yield was obtained when wheat was planted after paddy rice [31].

Also, these findings were well supported by many workers like [3], [10] and [34]. who found that further increase in biological yield of cereal after legume crop rather than after continuous preceding cereal crops.

{35}, {37} and {17}, studied the effect of preceding crops and nutrient management on growth, productivity and quality of wheat. They indicated that growing legume crop as the preceding crop resulted significant higher grain and straw yields of wheat than preceding maize crop.

Table 8: nitrogen , P, K and Protein concentration (%) of wheat grain as affected by the remnants of the preceding crops, mineral nitrogen fertilizer levels during 2016 /2017 and 2017/2018 seasons.

Treatments	N%		P%		K%		Protein%	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd
A-preceding crops								
Rice(fallow)	1.25	1.31	0.22	0.21	0.43	0.44	7.14	7.47
Drawa	1.33	1.44	0.24	0.26	0.46	0.46	7.60	8.11
Fahl berseem	1.55	1.59	0.28	0.30	0.50	0.51	8.82	9.01
L.S.D at 0.05	**0.0514**	**0.0143**	**0.00912**	**0.0019**	**0.0033**	**0.0041**	**0.2835**	**1.376**
F.T.	**	**	**	**	**	**	**	**
B- N-fertilization levels								
Control	1.16	1.24	0.21	0.23	0.33	0.34	6.61	7.03
35	1.36	1.41	0.26	0.25	0.49	0.49	7.79	8.04
70	1.61	1.69	0.29	0.30	0.57	0.58	9.16	9.63
L.S.D at 0.05	**0.0327**	**0.0293**	**0.0050**	**0.0033**	**0.0078**	**0.004**	**0.1863**	**1.1702**
F.T.	**	**	**	**	**	**	**	**

Found data in Table 8 observed that wheat grains N, P, K and protein concentration have been affected by treatments of previous crops and mineral nitrogen fertilizer rates. With respect of the first and second seasons; the highest values were obtained when wheat followed fahl berseem compared with the other preceding crops which recorded the height values (1.55, 1.59); (0.28, 0.30); (0.50, 0.51) and (8.82, 9.01) for N, P, K and protein concentration, respectively.

On the other hand the highest values of the same parameters were realized by apply the treatment of recommended dose from N fertililzer (70 kg $N.fed^{-1}$) (1.61, 0.29, 0.57 and 9.16) for N, P, K and protein% in the first season and (1.69, 0.30, 0.58 and 9.63) in the second one. These results may be due to increase in quantity of O.M which difference between seasons and temperature which helped root residues to analysis fastly to improve soil with a lot of available N.

Table 9: nitrogen, P, K and Protein concentration (%) of wheat grain as affected by the interaction between remnants of the preceding crops, mineral nitrogen fertilizer levels during 2016/2017-and 2017/2018 seasons.

Treatments		N%		P%		K%		Protein%	
		1st	2nd	1st	2nd	1st	2nd	1st	2nd
Rice(fallow)	Zero	1.07	1.14	0.19	0.19	0.29	0.31	6.09	6.49
	35	1.24	1.32	0.23	0.23	0.46	0.45	7.08	5.64
	70	1.44	1.48	0.26	0.27	0.53	0.55	8.22	8.43
Darawa	Zero	1.15	1.26	0.21	0.21	0.33	0.34	6.59	7.16
	35	1.29	1.34	0.24	0.25	0.48	0.48	7.41	7.39
	70	1.54	1.71	0.28	0.29	0.56	0.57	8.79	9.76
Fahl berseem	Zero	1.25	1.32	0.22	0.24	0.36	0.37	7.12	7.42
	35	1.55	1.57	0.31	0.32	0.54	0.54	8.87	8.94
	70	1.83	1.87	0.32	0.34	0.62	0.62	10.46	10.65
L.S.D at 0.05		**0.0567**	**0.0508**	**0.0567**	**0.0034**	**0.0567**	**0.0057**	**0.3227**	**-**
F.T.		**	**	**	**	**	**	**	**N.S**

Data presented in Table 9 reveal that fahl berseem as preceding crop treatments with recommended dose of N fertilizer (70 kg.N.fed^{-1}) produced the highest percentages of (N, P& K) in wheat grain(1.83, 0.325 & 0.620) and (1.87, 0.342 & 0.627) in the first and second seasons respectively. On the other hand, preceding crops with rates of N fertilizer treatments significantly affected protein % in the first season only. The highest value was observed with clover treatments + 70 kg N.fed^{-1}(10.46%) While protein had no significant affected in the second season.

These results agree with [21] and [14]. They studied the effect of preceding crops on protein content in winter wheat. They demonstrated that, protein content in wheat grain was to a greater extent determined by preceding legume crops rather that organic manure. These results may be due to C/N ratio of clover residue compared with other preceding crops. C: N ratio in cereal crops (rice and maize) is widely rather than C: N ratio in legumes which is narrow. Microorganisms such as bacteria need N to live and in decomposition process So it can break down legume residues in short time compared with cereal residues and improve available N and other minerals in soil which allow to uptake by root plants which effect on growth yield but wider C: N ratio in cereal residuals (roots) leading to immobilization of soil N.

Table 10: nitrogen, P, K and Protein concentration (%) of wheat straw (Triticum sp.) as affected by the remnants of the preceding crops, mineral nitrogen fertilizer levels during 2016 /2017 and 2017 / 2018 seasons.

Treatments	N%		P%		K%		Protein%	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd
A-preceding crops								
Rice(fallow)	0.41	0.42	0.076	0.078	1.438	1.437	2.328	2.399
Drawa	0.47	0.48	0.081	0.084	1.488	1.489	2.652	2.787
Fahl berseem	0.52	0.53	0.092	0.096	1.448	1.455	2.977	3.024
L.S.D at 0.05	**0.0088**	**0.0037**	**0.0047**	**0.0029**	**0.0074**	**0.0025**	**0.0496**	**0.1365**
F.T.	**	**	**	**	**	**	**	**
B- N-fertilization levels								
Control	0.38	0.38	0.068	0.072	1.298	1.298	2.131	2.193
35	0.47	0.48	0.084	0.085	1.493	1.496	2.657	2.775
70	0.56	0.57	0.096	0.101	1.581	1.587	3.170	3.242
L.S.D at 0.05	**0.0081**	**0.0019**	**0.0057**	**0.0014**	**0.0103**	**0.0030**	**0.044**	**0.1145**
F.T.	**	**	**	**	**	**	**	**

The data obtained from Table 10 show that a significant effect of residual crops (maize & clover) on N, P and K and protein concentration of wheat straw in both seasons. The highest values were obtained with residual effect of fahl berseem on N, P, K and protein% (0.52, 0.092, 1.44 and 2.97%) and (0.53, 0.096, 1.455and 3.02%) in first and second season respectively. High significant effect of mineral nitrogen fertilizer treatments on N, P, K and protein concentration in wheat straw in both seasons. Rate of 70 kg N.fed-1 (RD) gave better results in N (0.56 & 0.53 %), P (0.096 &0.101%), K (1.58 &1.58%) and protein (3.17 & 3.24%) in the first and second season respectively compared with the control treatment.

Table 11: nitrogen, P, K and Protein concentration (%) of wheat straw as affected by the interaction between remnants of the preceding crops with mineral nitrogen fertilizer levels during 2016 /2017 and 2017 / 2018 seasons.

Treatments		N%		P%		K%		Protein%	
		1st	2nd	1st	2nd	1st	2nd	1st	2nd
Rice (fallow)	**Zero**	0.31	0.32	0.060	0.063	1.24	1.29	1.77	1.83
	35	0.43	0.44	0.075	0.077	1.51	1.51	2.45	2.52
	70	0.49	0.50	0.091	0.093	1.56	1.55	2.77	2.85
Drawa	**Zero**	0.40	0.41	0.065	0.071	1..38	1.36	2.23	2.35
	35	0.46	0.46	0.082	0.085	1.52	1.52	2.61	2.81
	70	0.55	0.56	0.095	0.098	1.57	1.58	3.12	3.20
Fahl berseem	**Zero**	0.42	0.42	0.077	0.082	1.28	1.28	2.40	2.40
	35	0.51	0.53	0.095	0.093	1.45	1.46	2.91	3.00
	70	0.64	0.64	0.103	0.113	1.62	1.63	3.62	3.67
L.S.D at 0.05		**0.0141**	**0.0034**	**-**	**0.0025**	**0.0179**	**0.0052**	**0.0769**	**0.198**
F.T.		**	**	**N.S**	*	**	**	**	*

Interaction between root residual of maize and fahl berseem with rates of mineral nitrogen fertilizer significantly affected N, P, K and protein concentration where they increased P in the second season only (0.113%) While, P had no significantly affected in the first season . N, K and protein % in both season (Table 11) (fahl berseem+70 kg N.fed^{-1}) had the highest values (0.64, 1.62and 3.62) and (0.64, 1.63 and 3.67) in first and second season respectively, but the lowest values (0.31, 1.24 and 1.77) and (0.32, 1.29 and 1.83) were detected with control treatment in first and second season respectively. These results may be due to legumes promoted the growth of larger, more metabolically active microbial population which support greater nutrient mineralization and overall improvement of soil fertility, compared with continuous rice and maize.

Also, C:N ratio of rice residues more than 90:1 and maize was 88:1which causes decompose slowly in soil and therefore reduces N supply for the subsequent crop. The decomposition rate is expected to be higher for rice and maze crops than for legumes which have high C:N ratio and high lignin contents and decompose slowly.

These results agree with [2] who studied the effect of preceding rice and mineral fertilization by phosphorus and Zinc fertilizers with recommended dose from N and K on wheat straw yield under rice-wheat system, they observed that, the interaction between preceding and mineral fertilizers increase chemical composition of wheat straw yield. But these results less than legumes-wheat rotation.

Table 12: N-uptake and N utilization rate % of wheat as affected by remnants of the preceding crops with mineral nitrogen fertilizer levels during 2016/2017 and 2017/2018 seasons.

Treatments	N-uptake kg.fed^{-1}		N-Utilization rate%	
	1st	2nd	1st	2nd
A-preceding crops				
Rice (fallow)	32.24	33.67	23.50	24.52
Drawa	39.39	44.75	27.87	31.77
Fahl berseem	53.64	58.23	39.66	42.83
L.S.D at 0.05	**1.5443**	**0.4131**	**0.87118**	**0.5466**
F.T.	**	**	**	**
B- N-fertilization levels				
0	32.80	36.05	00.00	00.00
35	40.17	43.22	39.23	42.19
70	52.31	57.38	51.81	56.93
L.S.D at 0.05	**0.96**	**0.87**	**0.93**	**0.47**
F.T.	**	**	**	**

Generally, data in Table 12 show the values of N-uptake and values of N utilization rate % in the first and second seasons as affected by preceding crops and rates of mineral nitrogen fertilizer. The data indicated that residual of crops had a significant effect of N-uptake kg.fed^{-1}. Treatment of clover had given a best value of N-uptake Kg.fed-1 (53.64 & 58.23) in the first and second season respectively. The highest values of N utilization rate % were obtained with fahl berseem, compared with maize treatment.

Table 12 show that, the difference between rates of nitrogen fertilizer on N-uptake and values of N utilization rate% were significant. The control treatment had the lowest mean of N-uptake while, treatment of recommended dose gave the highest average of this parameters. Also, recommended dose from mineral nitrogen was gave the highest values of N utilization rate in both seasons.

Table 13: N-uptake and N utilization rate % of wheat as affected by the interaction between remnants of the preceding crops with mineral nitrogen fertilizer levels during 2016/2017 and 2017/2018 seasons.

Treatments		N-uptake kg.fed^{-1}		N-Utilization rate %	
		1st	2nd	1st	2nd
Rice (fallow)	Zero	25.03	26.33	00.00	00.00
	35	31.89	33.76	31.17	33.01
	70	39	40.93	39.33	40.55
Darawa	Zero	33.15	37.51	00.00	00.00
	35	37.55	40.27	36.60	39.2
	70	47.48	56.47	47.01	56.11
Fahl berseem	Zero	40.22	44.31	00.00	00.00
	35	51.07	55.63	49.92	54.37
	70	69.65	74.76	69.07	74.13
L.S.D at 0.05		**1.6766**	**1.508**	**1.61647**	**0.82135**
F.T.		**	**	**	**

Data in Table 13 present the effects of the interaction between preceding crops and rates of mineral nitrogen fertilizer on N-uptake kg.fed^{-1} and N utilization rate values. Data show that a significant effect was detected, where the control treatment had the lowest values while fahl berseem with 70 Kg N.fed^{-1} gave the highest values of N uptake. On the other hand, data show that The interaction between fahl berseem recommended dose gave the highest values of N utilization rate in both seasons.

Nitrogen efficiency indices significantly affected by crop rotation and N fertilizer rate [19]. Nitrogen utilization efficiency of wheat affected by preceding crop, application rate of nitrogen and crop residues. N-uptake, N Utilization efficiency in wheat Were significantly affected by preceding crop. Also fertilizer N rate applied on preceding crops [27].

Table 14: nitrogen,P, K mg.kg^{-1} and O.M% on soil after harvesting as affected by remnants of the preceding crops with mineral nitrogen fertilizer levels during 2016 /2017 and 2017 / 2018 seasons.

Treatments	N mg.kg^{-1}		P mg.kg^{-1}		K mg.kg^{-1}		O.M %	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd
A-crops								
Rice	28.48	29.24	14.36	16.25	234.33	235.85	1.33	1.38
Maize	30.21	31.92	16.16	18.45	243.88	249.68	1.39	1.43
Fahl Berseem	34.62	37.93	22.65	25.47	387.44	394.66	1.51	1.55
L.S.D at 0.05	**0.142**	**1.07**	**0.51**	**0.38**	**4.18**	**2.27**	**0.009**	**0.010**
F.T.	**	**	**	**	**	**	**	**
B- N-fertilization levels								
0	28.01	30.47	16.56	19.23	269.66	274.32	1.35	1.38
35	30.84	32.88	17.86	19.77	288.33	291.55	1.39	1.43
70	34.46	35.74	18.75	21.17	307.66	314.33	1.49	1.55
L.S.D at 0.05	**0.84**	**1.03**	**0.40**	**0.32**	**2.87**	**2.40**	**0.011**	**0.011**
F.T.	**	**	**	**	**	**	**	**

Table 14 represents the effect of previous crops and mineral nitrogen fertilizer on available N, P, K and O.M% in the soil after wheat harvesting. Significantly effects of all parameters (available N, P, K and O.M%) in the soil were detected. The highest values of available N, P, K and O.M% were recorded with preceding Fahl Berseem treatment. Table 16 show that differences between the rates of nitrogen fertilizer on available N, P, K and O.M% were high significant, where the control treatment had the lowest values while recommended dose gave the highest values of available N, P, K and O.M%.

Table 15: nitrogen,P, K mg.kg^{-1} and O.M% on soil after harvesting as affected by the interaction between remnants of the preceding crops with mineral nitrogen fertilizer levels during 2016 /2017 and 2017 / 2018 seasons.

Treatments		N mg.kg^{-1}		P mg.kg^{-1}		K mg.kg^{-1}		O.M %	
		1st	2nd	1st	2nd	1st	2nd	1st	2nd
Rice (fallow)	Zero	25.1	27.60	12.76	14.10	219	222.56	1.25	1.30
	35	28.36	29.90	14.73	16.50	235	234	1.29	1.33
	70	32	30.23	15.60	18.16	249	251	1.45	1.50
Drawa	Zero	26.93	29.06	15.50	17.23	227.66	229.4	1.31	1.35
	35	29.03	31.26	16.23	18.26	244.33	249	1.37	1.41
	70	34.66	41.56	16.76	19.86	259.66	270.6	1.51	1.55
Fahl Berseem	Zero	32	34.73	21.43	23.73	362.33	371	1.49	1.51
	35	35.13	37.50	22.63	25.60	385.66	391.6	1.52	1.56
	70	36.73	41.56	23.90	27.10	414.33	421.3	1.53	1.60
L.S.D at 0.05		1.46	1.79	0.70	0.55	4.98	4.16	0.019	0.019
F.T		*	*	*	**	**	**	**	**

Table 15 represents the effect of interaction between remnants of the preceding crops with mineral nitrogen fertilizer on available N, P, K and O.M% in the soil after wheat harvesting. Significantly effects of (available N) and a high significantly effects of another parameters (available P, K and O.M%) in the soil were detected. where the lowest values were recorded due to control treatments under preceding Rice-wheat treatment, while treatment with (70 kg N.fed^{-1}) gave better results under preceding Fahl Berseem in available N (36.73 and 41.56 mg kg^{-1}) in the first and second season, respectively. The highest values of available P (23.90 and 27.10 mg kg^{-1}) in the first and second season, respectively. The highest values of available K (414.33 and 421.3 mg kg^{-1}) in the first and second season, respectively and the highest values of O.M% (1.53 and 1.60%) in the first and second season, respectively .

These results agree with [34]. who found that the organic carbon content and available N, P and K in soil after harvest of wheat crop were significantly higher under preceding lover crop.

[36] studied the effect of preceding crops and nitrogen rates on soil organic carbon and total soil nitrogen content. They indicated that organic carbon and soil nitrogen content after legumes crops were found higher than after summer maize and follow.

[21] studied the effect of preceding crops and green manure on the fertility of clay loam soil. They showed that, the highest content of total N, humus, available P and K in the soil after lucerne as a preceding crop when green manure had been applied.

These results may be due to organic carbon content of soil under legume was probably due to addition of biomass of narrower C:N ration by legumes. Higher soil N content after legumes can be explained by mechanism of biological nitrogen fixation occurring in legumes. Also microorganisms produced organic acids which decrease soil pH and increase availability from P and K.

4. CONCLUSIONS

Cereal winter crops can be sow after preceding legume crops rather than summer cereal crops. We can sow fahl berseem crop as a forage to animals after cereal crop (rice) and before sowing wheat crop to improve soil properties and its availability of the essential elements and consider additional revenue to farmer. Fahl barseem had be sown in the end of august month after rice crop to produce approximetly 20 ton fresh forage.fed^{-1} (~ 9 ton dry grass.fed-1) which provides farmers with (~ 9 thousands EL) in 88 days only.

REFERENCES

1. Amanullah, Inamullah, Nawab KH, Shah Z. Preceding rice genotypes, residual phosphorus and zinc influence harvest index and biomass yield of subsequent wheat crop under rice-wheat system. Pak. J. Bot. 2015., 47(SI):265-273.

2. Aslam M, Mahmood IA, people MB, Schwenke GD, Herridge DF. Contribution of chickpea nitrogen fixation to increased wheat production and soil organic fertility in Rain-fed Cropping. Biol. and Ferti. of Soils. 2003., 38:59-64.

3. Bais HP, Broeckling CD, Vivanco JM. Root exudates modulate plant–microbe interactions in the rhizosphere in secondary metabolites in soil ecology. Soil Biol. 2008., 14: 241–252.

4. Black AC, Evans DD, White JL, Ensminyer EL, Clark EF. Methods of Soil Analyses. Soc. Agro. Ink. Madison Wiscosin USA. 1965.

5. Broeckling CD, Broz AK, Bergelson J, Manter DK, Vivanco JM. Root exudates regulate soil fungal community composition and diversity. Appl. Envir. Microbiol. 2008., 74: 738–744.

6. Campbell CA, Souster W. Present and Future Soil Nitrogen Trends Source. J. Soil Sci. 1982., 62: 651- 665.

7. Clark A. Managing cover crops profitably, 3rd ed. Sustainable Agriculture Network, Beltsville, MD. 2007.

8. Dat JS, Vandenabeele E, Vranova M, Van Montagu D, Inze, Van Breusegem F. Dual action of the active oxygen species during plant stress responses. Cell Mol. Life Sci. 2000., 57:779-795.

9. Dayegamiye AN, Whalen JK, Tremblay G, Nyiraneza J, Grenier M, Drapeau A, Bipfubusa M. The benefits of legume crops on corn and wheat yield, nitrogen nutrition, and soil properties improvement. Agron. J. 2015., 107(5):1653-1665.

10. Finck. "Fertilizer and Fertilization". Weinheim beer field beach florida. Basel: verleg chemical. 1982., Pp:223.

11. Fitter A. Ecology making allelopathy respectable. Sci. 2003., 301:1337-1338.
12. Gomez KA, Gomez CM. Statistical Procedure for Agriculture Research . John Wiley and Sons. Inc. New york. 1984.
13. Halvorson AD, Nielsen DC, Reule CA. Nitrogen fertilization and rotation effects on no-till dry land wheat production. Agron. J. 2004., 96:1196-1201.
14. Hutsch BW, Augustin J, Merbach W. Plant rhizodeposition an important source for carbon turnover in soils. J. Plant Nut. Soil Sci. 2000., 165: 397–407.
15. Jackson ML. "Soil Chemical Analysis" Prentic-Hall,India, New Delhi, 1967., p: 183-203.
16. Kumar B, Roy Sharma RP. Effect of Preceding Crops and Nitrogen Rates on Growth, Yield and Yield Attributes of Wheat. Indian Journal of Agricultural Research, 2000., 34(1): 34-38.
17. Lopez-Bellido RJ, Lopez-Bellido L. Efficiency of nitrogen in wheat under Mediterranean condition: effect of tillage, crop rotation and N fertilization. Field Crop Res. 2001., 71(1):31-64.
18. Maadi B, Fathi G, Siadat SA, Alami K, Jafari S. Effect of preceding crops and nitrogen rates on grain yield and yield components of wheat (*Triticum aestivum L.*). world Applied Sci. J. 2012., 17(10):1331-1336.
19. Maiksteniene S, Arlauskiene A. Effect of preceding crops and green manure on the fertility of clay loam soil. Agron Res. 2004., 2(1):87-97.
20. Nguyen C. Rhizodeposition of organic C by plants: mechanisms and controls. Agron. 2003., 23: 375–396.
21. Philippe H. Rhizosphere: a new frontier for soil biogeochemistry. J. Geol. Exp. 2006., 88: 1-3, 210-213.
22. Rocio CO, Aurora L, Shukla KP, Sharma S, Singh NK, Singh V, Tiwari K, Singh S.. Nature and role of root exudates: Efficacy in Bioremediation. Afric. J. of Biotec. 2011., 10(48): 9717-9724.
23. Rahimizadeh M, Kashani A, Zare-Feizabadi A, Koocheki AR, Nassiri-Mahallati M. Nitrogen use efficiency of wheat as affected by preceding crop, application rate of nitrogen and crop residues. Aust. J. of crop Sci. 2010., 4(5): 363-36.
24. Shah Z, Ahmed SR, Rahman H. Sustaining rice-wheat system through management of legumes I: Effect of green manure legumes on rice yield and soil quality. Pak. J. Bot. 2011., 43:1569-1574.
25. Siadat SA, Moradi-Telavat MR, Fathi G, Mazarei M, Alamisaeid K, Mousavi SH. Rapeseed (*Brassica napus* L. var. oieifera) Response to Nitrogen Fertilizer Following Different Previous Crops. Italian Journal of Agronomy. 2011., 6(31): 199-203.

26. Stintzi A, Browse J. The Arabidopsis male-sterile mutant, opr3, lacks the 12-oxophytodienoic acid reductase required for jasmonate synthesis. Proc. Natl. Acad. Sci. 2000., 97: 10625–10630.

27. Stotz HU, Pittendrigh BR, Kroymann J, Weniger K, Fritsche J, Bauke A, Mitchell OT. Induced plant defense responses against chewing insects, ethylene signaling reduces resistance of *Arabidopsis*

28. against Egyptian cotton worm but not diamondback moth. Plant Physiol. 2000., 124: 1007–1018.

29. Skuodiene R, Nekrosiene R. Effect of preceding crops on the winter cereal productivity and diseases incidence. Acta Agric. Slovenica. 2009., 93(2): 169-179.

30. Usadadiya VP, Patel RH, Hirapara BV. Effect of preceding crops and nutrient management on growth, productivity and quality of wheat in irrigated conditions. Inter. J. of Agriv. Innov. And Res. 2014., 2(4): 463-465.

31. Yadav BP, Yadav DN, Koirala KB, Pandey KR, Thapa RB. Effect of preceding crops and nitrogen rates on soil organic carbon and total soil nitrogen content. Int. J. Grad. Res. 2016., 2(1): 21-24.

32. Zen El-Dein AAM, Seif El-Nasr FM. Effect of residual and straw for three preceding crops on growth, yield and yield components of wheat under different nitrogen fertilizer levels. J. Agric. Res. Kafr El-Shaikh Univ. 2016., 42(2):160-172.