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# Effect of Composted Rice Residues and NPK on Yield and Yield Components of Lentil Grown in Sandy Soil

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**Abstract:** Two field trials were conducted using lentil (*Lens culinaris L.*) variety Giza 370 at Research and Productions station, National Research Centre, Alemam Malek village, Al Nubaria district, Al Behaira Governorate, Egypt in 2008/09 and 2009/10 winter seasons. The experimental treatments were 100% recommended dose of organic fertilizer in the form of composted rice residues (4 ton/fed.). , 75 % rec. organic fertilizer + 25% NPK (3 ton/fed. + NPK 5:8:6). ,50 % rec. organic fertilizer + 50% NPK (2 ton/fed.+ NPK 10:16:12). ,25 % rec. dose of organic fertilizer + 75% NPK (1 ton/fed. + NPK 15:24:18). and 100 % rec. NPK (NPK 20:32:24). Results indicated significant differences between treatments in all studied characters. Treatment of organic fertilizer recorded the best results and NPK 20:32:24 came the second in yield and all yield attributes, it is identically ranged from 93% in number of capsules/plant to 98.5% in seed index from the best treatment.

***Key words:*** Lentil, composted rice, NPK fertilizer.

## INTRODUCTION

The benefits of grain legumes in cropping systems are well established, they can fix substantial amounts of atmospheric $N_2$ which allows them to be grown in N-impoverished soils with low fertilizer N inputs. Lentil is one of the important seed legume crops worldwide i.e Asia and north Africa. In Egypt it ranks second after faba bean from the stand point of importance as legume crop, the cultivated area is relatively small (1096.38 feddan) with sharp decrease in Delta and Nile valley AERMAE[1].

Thus, new reclaimed sandy soil is suitable for lentil sown in Egypt to avoid the severe competition lentil acreage with other traditional and strategic winter feeding crops i.e wheat (*Triticum aestivum* L) for humans and clover berseem (*Trifolium alexandrinum* L.) for animals on the limited arable land in Nile valley.

Residues of rice crop in Egypt are estimated by 3.2 million ton/year, the above-ground residues are removed with the grain to be used as animal feed or cooking fuel, thus composted ash and residues of rice crop and reuse as organic fertilizer is one of the important target under Egyptian agriculture. For farmers to change their farming practices and retain such residues, they would need to be convinced that the residues have more values as a source of soil organic matter and nutrients for plant growth than as feed or fuel.

Improved management of nitrogen N in low fertility soil is critical for increased land productivity and economic sustainability. Doran *et al*.,[4] and Power *et al*.,[12] concluded that returning residues to the soil may be moderate extremes of soil temperatures and improve soil organic matter levels, soil structure and the infiltration, storage and utilization of soil water.

Peoples and Craswell,[11] stated that the above –ground residues, remaining after the seed and other components of the crop have been harvested, represent a potentially valuable source of N for replenishing soil N pools. Elkramany and Bahr.,]6[ reported the best benefits of chickpea from organic fertilizer treatment. Shah *et al*.,[14] reported that grain yield benefits of amendment crops residues for soil were 13% for mungbean and 8% for wheat and lentil, also, soil organic N and total organic were increased by N inputs from both N fertilizer and residues. Amujoyegbe *et al*.,[2] indicated significant variability and diversity observed on yield and yield components of maize and sorghum due to mixture of organic and inorganic fertilizers source, El kramany *et al*.,]5[ and Seema *et al*.,[15] stated superiority action of both bio-organic and chemical fertilizers (25% recommended NPK+75% FYM+biofertilizer) gave the best groundnut yield ,yield components and oil yield.

El kramany *et al*.,[7] found that 50% of both chemical and organic fertilizers recommended rates which were NPK 10:15:12 and 1.5 ton/fed. of composted rice residues and bio-fertilizer gave the best yield and yield components of chickpea sown in sandy soil compared to full dose of either NPK 20:30:24 or 3 ton/fed. organic fertilizer. Kabesh *et al*.,[9] pointed that replacement 25% from recommended dose of NPK by organic fertilizer of 2.5 $m^3$/fed. + Commerce product of bio-fertilizer contain *Azospirillum sp*. gave the highest grain, straw

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and biological yields. Sary *et al*.,[13] pointed out the superiority of 2.5 ton chicken manure + NPK 57:22:36 produced the best grain yield and protein, P, K (kg/fed.) in wheat.

## MATERIALS AND METHODS

Two field trials using lentil *(Lens culinaris L.)* variety Giza 370 were conducted at research and production station, National Research Centre, Alemam Malek village, Al Nubaria district, Al Behaira Governorate, Egypt in 2008/09 and 2009/10 winter seasons. The experimental soil was analyzed according to the method described by Chapman and Pratt[]. Soil texture was sandy and having the following characteristics:

Experimental soil ploughed twice and divided to plots 10.5 $m^2$ – 1/400 fed. (fed. = feddan = 4200 $m^2$) Seeds rate was 50 kg/ fed. inoculated with specific strain of (*Rhizobium leguminosarum*) in plots contain 15 rows 20 cm. between each, 3.5 m in length in hills 20 cm apart then irrigated immediately after sown. Organic manure was mixed with soil before sowing at the rate of each treatment. Sowing date was first week of November in both seasons. Organic fertilizer was composted rice residues and the chemical composition of organic manure presented in Table 2. Starter dose of nitrogen N 10 as ammonium nitrate 33% N were applied before sowing. Twice hand weeded at 21 and 35 DAS. The experimental design was complete randomized block design in three replicates.

The experimental treatments can be described as follows:-

1- 100% recommended dose of organic fertilizer in the form of composted rice residues (4 ton/fed.)
2- 75 % rec. organic fertilizer + 25% NPK (3 ton/fed. + NPK 5:8:6).
3- 50 % rec. organic fertilizer + 50% NPK (2 ton/fed.+ NPK 10:16:12).
4- 25 % rec. dose of organic fertilizer + 75% NPK (1 ton/fed.+ NPK 15:24:18).
5- 100 % rec. NPK (NPK 20:32:24).

Nitrogen was applied in the form of ammonium nitrate 33.5% N in two portions 21 and 42 DAS. Phosphorus in the form of calcium superphosphate 15.5% $P_2O_5$ incorporated with soil before sowing. Potassium in the form of potassium sulfate 48% $K_2O$ was added before sown. The normal cultural practices for growing lentil in sandy soil were applied as recommended. At harvest 130 DAS two central rows were harvested and sub samples of 10 plants , were taken randomly to estimate the yield attributes as follows :-

1- Plant height (cm). 2- Number of branches/plant. 3- Number of capsules/plant
4- Seed yield (g/plant). 5- Seed index (weight of 100 seeds).

The whole plot was harvested to determine:-

6- Seed yield (kg/fed.) 7- Straw yield (kg/fed.) 8- Biological yield (kg/fed.).
9- Harvest index (seed yield (kg/fed.) /bio-yield (kg/fed.). 10- N% in seeds.

All data were statistically analyzed and combined analysis was conducted for the data of the two seasons according to Snedecor and Cochran]16[ - Gomez and Gomez[8]. The least significant difference (LSD) at 5% was used to compare between means.

**Table 1:** Mechanical and chemical analysis of experimental soil

| Sand% | Silt% | Clay% | pH | Organic matter, % | $CaCO_3$% | E.C. dS/m | Soluble N, ppm | Available P, ppm | Exchangeable K, ppm |
|---|---|---|---|---|---|---|---|---|---|
| 91.2 | 3.7 | 5.1 | 7.3 | 0.3 | 1.4 | 0.3 | 8.1 | 3.2 | 20 |

**Table 2:** Chemical composition of organic fertilizer (composted rice residues)

| N % | P % | K % | C/N ratio | Organic matter % | PH | Dry weight of 1 $m^3$ |
|---|---|---|---|---|---|---|
| 1.5 | 0.58 | 1.24 | 17-Jan | 36.56 | 8.8 | 460(kg) |

## RESULTS AND DISCUSSION

Data presented in Table (3) show effect of combination between composted rice residues and NPK on yield and yield components of lentil variety Giza-370. Data clear that there were significant differences among treatments for all studied characters.

**1. Plant Height (Cm):** Data presented in Table 3 show that treatment of 100 % recommended dose of NPK produced the tallest plants 32.1 cm followed by treatment of 25 % rec. dose of organic fert. + 75 % rec. NPK 30.2 cm and the third 50 % rec. dose of organic fert. + 50 % rec. NPK 27.2 cm which parity 94% and 84% from the best treatment

**2. Number of Branches/plant:** Treatment of 100% NPK 20:32:24 produced plants have the highest number of branches 3.4 , the second was 25% rec. dose of org. fert. + 75% NPK 15:24:18 3.2 and the third was treatment of 50% rec. dose of both org. fert. and NPK 2.5 which identically 94% and 73% from the first order.

**3. Number of Capsules/plant:** It is clear from data in Table 3 that the best treatment due to no. of capsules was 100% NPK 52.2 followed by 25% rec. org. fert. + 75% rec NPK recorded the second order 48.8 and the third was 50% rec. dose of both org. fert. and NPK 48, there were in symmetry of 93% and 92% from the best.

**4. Seed Yield (g/plant):** The greatest seed yield 5.62 g/plant produced by addition of 100% rec. NPK, treatment of 25% rec. org. fert. + 75% NPK came in the second order 5.38 and the third was 50% rec. dose of both org. fert. and NPK 5.1, they are in symmetry of 96% and 91%. Superiority of the treatment may be due to the same trend in plant height, no. of branches and no. of capsules/plant which reflected on seed yield/plant as result of this attributes.

**5. Seed Index (100 Seed Weight in Gram):** Data in Table 3 clear that the same trend recorded in forerunner attributes is true in seed index, 100% NPK gave the heaviest 100 seed 2.74 g , 25% rec. org. fert. + 75% rec. NPK came in second order 2.70 and 50% rec. dose from both org. and NPK fertilizers was third 2.51 g which parity 98.5% and 91% from the first order.

**6. Seed Yield (Kg/fed):** Data in Table 4 show the superiority of 100% NPK treatment in producing the highest seed yield 555 kg./fed. , this result is in uniformity of all yield components i.e plant height, no. of branches, no. of capsules per plant, seed yield/plant and weight of 100 seed (seed index). Treatment of 25% rec. org. fert. + 75% NPK came in the second order 525 kg/fed. and followed by 50% rec. of both org. fert. and NPK 466 kg/fed. which identity 94% and 84% compared to the first order, combined effect of dual types org. and NPK fertilizers in increasing seed yield in field crops sown in sandy soil reported by many researchers Shah *et al*.,[4]reported 13% increase for mungbean, 8% for wheat and lentil also, soil organic N and total organic were increased, El kramany *et al*.,[7] pointed the dual effect of organic fertilizer (chicken manure) beside 75% of recommended NPK on yield and yield components of chickpea growing in sandy soil, Sary *et al*.,[13] stated the same result on wheat.

**7. Straw Yield (Kg/fed):** Treatment of 25% rec. org. fert.+75% rec. NPK produced the highest straw yield 387 kg/fed. follow by 100% NPK 373 kg/fed. and 50% of both org. fert. and NPK identity 96% and 91% from the first order, the increases have been attributed to mineralization and N-rich residues of both NPK and organic fert..

**8. Biological Yield (Kg/fed):** The greatest biological yield 928 kg/fed. produced by addition of 100% rec. NPK, treatment of 25% rec. org. fert. + 75% NPK came in the second order 912 kg/fed., the third was 50% rec. dose of both org. fert. and NPK 821 kg/fed., they are in symmetry of 98% and 88% from the best treatment,

**9. Harvest Index%:** It is clear from data in table 4 that the highest harvest index% 59.8 recorded by treatment of 100% rec. NPK followed by 25% rec. org. fert+75% rec. NPK 57.5 and 50% rec. of both org. fert. and NPK 56.7, this result is in harmony with the trend recorded in seed yield and biological yield per feddan.

**10. N % in Seeds:** Data presented in Table 4 show that superiority of 100% rec. NPK in yield and most yield attributes was also true in N% in seeds of lentil 4.32% ,also, the same trend 25% rec. org. fert.+75% rec. NPK was second 4.24% and the third was 50% of rec. org. fert.+50% rec. NPK 4.20, result was in accordance of Nalle *et a*l.,[10].

**Table 3:** Effect of combination between composted rice residues and NPK on yield and yield components of lentil in sandy soil.

| Attributes Treatments | Plant height(cm) | No. of branches/plant | No. of capsules/plant | Seed yield/plant | Seed index |
|---|---|---|---|---|---|
| 4 ton/fed.org. fert. | 25.9 | 1.8 | 43.2 | 4.32 | 2.42 |
| 3 ton/fed. org. fert.+NPK 5:8:6 | 25.0 | 2.2 | 44.2 | 4.66 | 2.44 |
| 2 ton/fed. org. fert. + NPK 10:16:12 | 27.2 | 2.5 | 48.0 | 5.11 | 2.51 |
| 1 ton/fed. org. fert. + NPK 15:24:18 | 30.2 | 3.2 | 48.8 | 5.38 | 2.7 |
| NPK 20:32:24 | 32.1 | 3.4 | 52.2 | 5.62 | 2.74 |
| LSD (0.05) | 2.20 | 0.80 | 1.12 | 0.22 | 0.12 |

org. = organic - fert. = fertilizer - Seed index = (100 seed weight in g)

**Table 4:** Effect of combination between composted rice residues and NPK on yield and yield components of lentil in sandy soil.

| Attributes Treatments | Seed yield (kg/fed.) | Straw yield ( kg/fed.) | Biological yield (kg/fed.) | Harvest index %. | N % in seeds |
|---|---|---|---|---|---|
| 4 ton/fed.org. fert. | 425 | 340 | 765 | 55.5 | 4.00 |
| 3 ton/fed. org. fert.+NPK 5:8:6 | 435 | 340 | 775 | 56.1 | 4.10 |
| 2 ton/fed. org. fert. + NPK 10:16:12 | 466 | 354 | 821 | 56.7 | 4.20 |
| 1 ton/fed. org. fert. + NPK 15:24:18 | 525 | 387 | 912 | 57.5 | 4.24 |
| NPK 20:32:24 | 555 | 373 | 928 | 59.8 | 4.32 |
| LSD (0.05) | 12.20 | 8.2 | 18.2 | 1.1 | 0.08 |

org. = organic - fert. = fertilizer

**Conclusion:** It can be concluded that interaction between 75% recommended dose of NPK (15:24:18) + 25% of recommended dose of organic manure in the form of composted rice residues (1 ton/fed.) can be in the second order for all studied characters, it is identically ranged from 93% in number of capsules/plant to 98.5% in seed index from the best treatment, so, it can be recommended by these treatment as a good tool for reducing amount and cost of NPK in the chemical form and target to recycle rice residues without loss in biomass or pollution by burning it under Egyptian agriculture.

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