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EFFECT OF SOME MINERAL AND ORGANIC NITROGEN SOURCES AND THEIR COMBINATIONS ON YIELD AND YIELD COMPONENTS OF RICE

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ABSTRACT

The combination of urea or ammonium sulphate (A\so4) with farmyard manure (FYM) as well as using anyone of them alone as a source of nitrogen for rice cultivation was studied at Rice Research and Training Center (RRTC), Sakha, Kafr EL-Sheikh Governorate, Egypt during 2005 and 2006 seasons. The results revealed that, grain and straw yields and yield components significantly increased with the application of nitrogen sources in comparison to unfertilized check. There were no significant differences between urea and ammonium sulphate on the above mentioned characters. The ability of FYM alone to provide nitrogen is insufficient because of its lower N-content and higher C\N ratio. Generally, the combination of urea or ammonium sulphate with FYM in 75:25 ratio and full dose of mineral fertilizer either urea or ammonium sulphate gave the same effect of yield and yield components of rice. Under this study we can recommended that application of urea or ammonium sulphate or its combination with FYM in ratio 75:25 gave the best grain yield of rice.

INTRODUCTION

Rice crop plays a significant role in Egypt strategy for sustaining the food self- sufficiency. Rice, which occupies about 1.5 million fed produces approximately 6 million metric tons of rough rice annually (Ministry of Agriculture and Land Reclamation, 2007). Increasing nitrogen efficiency through use best nitrogen sources is one of the most important factors that limits productivity of rice. Among various nitrogen fertilizer sources, ammonium sulphate and urea are the most common. In recent years, fertilizer cost and concern for sustainable soil productivity and ecological stability in relation chemical fertilizer use have emerged as important issues. There is a renewed interest in organic manures, such as farmyard manures, compost and green manures, as sources of plant nutrients.

The growth and yield of lowland rice significantly increased with the combined use of organic materials with nitrogen fertilizer in an acid-lateritic soil. Such as the application of farmyard manure (FYM) or water hyacinth compost (WHC) at 10t/ha along with paddy straw (PS) at 2.5t/ha increased grain yield by 28% similar to the increase given by 30kg N/ha as fertilizer. The combination of FYM and WHC with or without PS produced yields equivalent to those using 50-60 kg N/ha as fertilizer urea (Sharma and Mittra, 1988).Using urea as a source of nitrogen was more efficient than ammonium sulphate in number of panicles/ m^2, panicle grain weight, number

of filled grains/panicle, grain yield/ha and N uptake. However, there was no significant difference between the two sources of nitrogen when they banded deep in the soil (Badawi and Ghanem, 1991).There was no significant difference between urea and ammonium sulphate (A/so_3) alone or in combination with FYM on number of productive tillers as well as straw yield. The application of A/so_3 alone or in combination with organic manure resulted in a significantly higher grain yield than that of urea (Sharif Zia *et al.*, 1992). Incorporation of farmyard manure increased the grain yield of rice in conjunction with fertilizer at 75% of the recommend dose.

The beneficial effect of manuring on soil fertility build up in respect of total N and available P was more pronounced at 75% as compared to 100 and 125 % level of fertilizer but that was reverse in case of available K (Pramanick and Das, 2000).Straw and grain yields were prominently higher with each increase in graded dose of either mineral nitrogen fertilizer or farmyard manure from 0 to 60 kg/ha and 0 to 4 t/ha respectively. There were no significant difference in straw and grain yield due to application of 30 and 60 kg N/ha in the rice crops treated with farmyard manure (Chakraborty *et al*., 2003). Under transplanted rice conditions, number of effective tillers/hill, number of grains/panicle and grain yield were significantly affected by the interaction between green manure and different levels of nitrogen. Nitrogen fertilizer application could be reduced to 50% of the recommended dose due to green manuring (Pramanik *et al*., 2004).

The rate of chemical fertilizer can be reduced by 33% for both dry and wet season rice in Bangladesh by using cow dung and ash in dry season. The practice of integrated use of organic cow dung, ash and chemical fertilizer yielded an apparent positive balance of P and K in soil. If cow dung and ash are applied to the rice crop, chemical P and K fertilizers dose may be reduced accordingly (Saleque *et al.*, 2004). All growth characters, yield parameters and grain yield increased significantly with an application of sulphur-containing nitrogen fertilizer (ammonium sulphate). Non- sulphur-containing nitrogen fertilizer, urea gave lowest value of growth characters, yield parameters and grain yield (Building *et al.*, 2005). Grain yield and straw yield obtained from manurial treatments (cow dung, paddy straw, sesbania and farmyard manure) were not significantly different from the yields obtained from inorganic fertilizer. The yield advantage on application of cow dung and other organic sources due to their capability to supply essential nutrients other than N, P and K. Application of green manure or cow dung or farmyard manure is known to increase concentrations of Fe, Mn, Cu and Zn in rice and rice based cropping systems (Banik *et al.*, 2006). Grain yield of rice was significantly higher (49.4%) in FYM-treated plots than in control plots. It was closely followed by (47%) higher than that $N_{120}P_{30}K_{30}$-plots. However, there was no significant difference in the grain yield of FYM and $N_{120}P_{30}K_{30}$-plots. The balanced fertilization improved the grain yield of rice. Similar was the trend in straw yield (Rasool *et al.*, 2007). Yield parameters (number of fertile tillers/plant, 1000-grain weight and total biomass) and grain yield of rice significantly increased with use of chemical fertilizer alone or in combination with various organic materials applied in the form of sesbania green manure, FYM and compost (Sarwar *et al.,* 2008).

Press mid cake (PMC) was evaluated as a source of nitrogen and phosphorus for rice-wheat cropping. The application of 60 kg N/ha along with PMC (5t/ha) produced grain yield of rice similar to that obtained with application of 120 kg N/ha in unamended plots (Singh *et al.*, 2008)

The objective of this study is to examine the integrated effect of mineral and organic nitrogen sources on the grain yield and yield components of rice variety Sakha 104.

MATERIALS AND METHODS

Field experiments were conducted during 2005 and 2006 seasons at Rice Research and Training Center (RRTC) Farm, Sakha, Kafr El-Sheikh governorate, using rice variety Sakha 104 (short grain, Japonica quality variety, suitable for saline areas and mixture irrigation water sites). The soil of the experimental site was clay, having pH 7.8, organic matter 1.98-2.0%. The available nitrogen was 15-20 ppm. The treatments compared among some of combinations of the different nitrogen sources (urea, ammonium sulphate and farmyard manure FYM) as well as an unfertilized treatment. Well decomposed farmyard manure contained (1.3%N) incorporated into the dry soil before flooding. The experimental design was a randomized complete block (RCBD) with four replications. The plot size was 15 m2 (3x5m). The treatments were as follows:

1- Unfertilized treatment
2- 100% urea (46%N)
3- 100% ammonium sulphate (20.5%N)
4- 100% farmyard manure FYM (1.3%N)
5- 25% urea +75% FYM
6- 25% ammonium sulphate + 75 %FYM
7- 50% urea +50 %FYM
8- 50% ammonium sulphate +50 % FYM
9- 75 % urea + 25 %FYM
10- 75 % ammonium sulphate + 25 % FYM

The added dose was 69 kg N/fad in all fertilizer treatments according to nitrogen percentage in the fertilizer. The mineral fertilizer added in two doses, the first (two third) was incorporated in dry soil before flooding, while the second; (one third) was applied as a top –dressing, five days before panicle initiation. Thirty days old seedlings were transplanted at a spacing of 20x20 cm. About 3 to 4 seedlings were transplanted in each hill at the first week of June. All management practices were done in proper time starting of land preparation to crop harvest. Panicle length, panicle weight, 1000-grain weight, number of filled grains/panicle and the percentage of unfilled grains/panicle recorded from ten randomly selected panicles were threshed and the previous characters were calculated . The number of panicles/m^2 and yields of rice estimated from a unit area of 8 m^2 in each plot. Harvest index calculated according to the formula, harvest index = (grain yield\biological yield) x 100. All collected data were subjected to the standard statistical analysis according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

1- Yield components

Results in Table (1) indicated that nitrogen fertilization applied either as mineral or organic sources or their combinations significantly increased number of panicles/m^2 as compared with the control treatment in both seasons. The highest numbers of panicles/m^2 were 618 and 615 produced from application of urea alone in the first and second seasons, respectively. On the contrary, the control treatment gave the lowest one (309 and 483 in 2005 and 2006, respectively). On the other hand, no significant difference was obtained between mineral nitrogen sources. Using full dose of farmyard manure alone significantly recorded lower number of panicles/m^2 than both of the two mineral sources of nitrogen.

Table (1): Some Yield components of rice as affected by different sources of nitrogen fertilization in2005 and 2006 seasons.

Characters	Number of panicles \m^2		Panicle length (cm)		Panicle weight (g)	
Treatments (sources of nitrogen)	2005	2006	2005	2006	2005	2006
Unfertilized treatment	309 e	483 e	19.03 d	19.70	2.87 b	3.30
Urea (46.5 % N)	618 a	615 ab	20.43 bc	21.08	3.96 a	3.63
Ammonium sulphate (20.5 % N)	617 a	591 abc	20.80 abc	20.37	3.79 a	3.92
Farm yard manure (FYM 1.3 % N)	388 de	504 de	19.73 bcd	19.69	3.73 a	3.44
Urea (25%) + FYM (75%)	389 de	516 cde	19.59 cd	20.05	3.54 a	3.50
A. sulphate (25%) + FYM (75%)	420 cd	507 de	20.05 bcd	19.92	3.51 ab	3.71
Urea (50%)+ FYM (50%)	491 bc	576 a-d	20.68 abc	20.94	3.69 a	3.61
A. sulphate (50%)+ FYM (50%)	517 bc	561 b-e	20.94 ab	20.23	3.65 a	3.53
Urea (75%) + FYM (25 %)	579 ab	653 a	21.84 a	20.95	4.18 a	3.81
A. sulphate (75%) + FYM (25 %)	523 ab	645 a	21.71 a	20.07	4.06 a	3.71
Significance at 0.05 level	*	*	*	Ns	*	Ns

Means designated with the same letter (s) in the same column are not significantly different at 0.05 level of probability.

With regard to panicle length (cm), data in Table (1) revealed that fertilization applied either by mineral or organic sources or their combinations produced significantly taller panicles compared to unfertilized in the first season only. The differences among the fertilization treatments were not significant in the second season. The combination of using urea (75 %) and FYM (25 %) was recorded the tallest panicles followed by ammonium sulphate and FYM (25 %) without any significant differences in the previously mentioned character. The differences among the two mineral sources without FYM and the combination of both of two mineral sources either 75n % or 50 % with FYM were in-significant.

Concerning panicle weight (g), results in Table (1) indicated that the application of both organic and inorganic nitrogen sources had a significant effect on panicle weight in the first season only. The maximum weight of panicle was observed in application of the combination of urea 75% and FYM 25 % followed by the combination of ammonium sulphate 75 % and 25 % without any significant differences between them. In general the differences

among the two mineral sources and all their combination with FYM were non-significant.

With respect to 1000-grain weight (g), results in Table (2) showed that the integrated use of organic and inorganic nitrogen fertilizer significantly increased such component in the first season only. Comparisons of individual treatment means indicated that maximum 1000- grain weight of 31.29g was recorded in nitrogen treatment of urea 75 % and FYM 25 % followed by 75 % ammonium sulphate integrated with 25 % FYM. Both treatments were statistically in line with each other without any significant differences. There was no significant difference between urea and ammonium sulphate in 1000-grain weight as a source of nitrogen fertilizer under this study.

Table (2): Some yield components of rice as affected by different sources of nitrogen fertilization in 2005and 2006seasons.

Characters / Treatments(sources of nitrogen)	1000-grain weight (g)		Number of filled grains\panicle)		Unfilled grains\panicle (%)	
	2005	2006	2005	2006	2005	2006
Unfertilized treatment	28.84 cde	29.88	108.8 c	98.3 c	3.9 ab	6.1
Urea (46.5 % N)	29.05 cde	29.91	131.4 a	122.1 a	5.9 a	5.6
Ammonium sulphate (20.5 % N)	29.93 bc	30.28	131.4 a	119.3 ab	4.9 ab	5.5
Farm yard manure (FYM 1.3 % N)	28.69 cde	29.88	121.2 b	111.3 b	3.2 c	4.2
Urea (25%) + FYM (75%)	29.02 cde	30.28	121.3 b	112.2 b	4.9 ab	5.4
A. sulphate (25%) + FYM (75%)	27.82 e	30.91	124.4 ab	112.0 b	4.2 bc	5.0
Urea (50%)+ FYM (50%)	28.56 de	30.64	129.1 ab	121.5 a	5.2 ab	5.1
A. sulphate (50%)+ FYM (50%)	29.21 bcd	30.16	128.4 ab	125.5 a	5.4 ab	4.6
Urea (75%) + FYM (25 %)	31.29 a	30.93	133.1 a	123.1 a	5.3 ab	5.2
A. sulphate (75%) + FYM (25 %)	30.51 ab	31.14	132.7 a	123.1 a	5.4 ab	5.5
Significance at 0.05 level	*	Ns	*	*	*	Ns

Means designated with the same letter (s) in the same column are not significantly different at 0.05 level of probability.

For number of filled grains\panicle results in Table (2) indicated that either mineral or organic source or their combinations with FYM significantly increased number of grains/panicle. The highest number of grains/panicle was observed from urea 75 % with 25 % FYM followed by the application of ammonium sulphate with FYM in percentage 75 % and 25 % in the first season. The integrated use of ammonium sulphate 50 % and 50 % FYM recorded the highest number of filled grains/panicle followed by the combination of either urea or ammonium sulphate with FYM in percentage 75 % and 25 %, respectively in the second season. The difference between urea and ammonium sulphate was not significant in number of filled grains\panicle.

With respect to percentage of unfilled grains\panicle, data in Table (2) point out that the application of both organic and inorganic nitrogen sources had a significant effect on percentage of unfilled grains\panicle in the first season only. The lowest percentage of unfilled grains\panicle was observed when farmyard manure was used as full dose of nitrogen fertilizer. The highest percentage of unfilled grains\panicle was obtained in treatment receiving nitrogen full dose from urea.

From the previous observation of yield components of rice, increasing the above mentioned components under the integrated use of mineral and organic fertilizer may be due to immediate release and availability of nutrients from mineral fertilizer and the benefit of organic fertilizer in increasing soil aggregation, infiltration, microbial activity, structure and water holding capacity, and can reduce soil compaction and erosion. Meanwhile, chemical properties improved by manure application include cation exchange capacity and soil buffering potential. Although farmyard manure is slow nutrient release, its consider an important source for micro and macro elements in the long run during growth stage of plant (Banik, *et al.,* 2006).

2- Yields of rice and harvest index

For grain yield, results in Table (3) indicated that highest mean of grain yield of rice recorded under different treatments was significantly higher over control. Integrated use of organic and inorganic nitrogen fertilizer significantly increased grain yield (t\fed). The highest grain yield was observed in treatment receiving nitrogen from urea and FYM in 75:25 ratio followed closely by treatment receiving nitrogen from ammonium sulphate and FYM in 75:25 ratio, and values for these two treatments were not significant in both seasons. Treatments receiving nitrogen solely from urea or ammonium sulphate produced comparable grain yield and the difference was non-significant. The lowest value of grain yield was produced under control treatment followed by the treatment receiving full dose of nitrogen from farmyard manure. These results may be attributed to the vital role of nitrogen on all yield components. The improvement in grain yield of rice was due to different processing occurring in a chain as a result to adding farmyard manure. Farmyard manure enhance the organic matter status of the soil that has been regarded a key factor determining soil fertility and productivity. This increase in soil organic matter content improve the physical properties of the soil and would have caused increased in root development that acted positively in more uptakes of water and nutrients. The decomposition of applied organic material resulted in reduction of soil PH as various acids or acid forming compounds were released from the addition of organic materials. This reduction in soil PH increased the availability of nutrients of alkaline soil that were used by the plants (Sarwar. *et al.*, 2008). The present results agree with Sharma and Mittra (1988).

With regard to straw yield, data in Table (3) revealed that a similar trend to grain yield was observed in straw yield. Nitrogen fertilization applied either by mineral or organic sources or their combination increased significantly straw yield as compared with the control treatment. The comparison between urea as full dose of nitrogen and ammonium sulphate as full dose of nitrogen showed non-significant effect on straw yield. The other comparisons were similar to that mentioned in grain yield.

For harvest index, results in Table (3) indicated that harvest index showed variable response to different fertilizer treatments. For example, the control treatment and the treatment of integrated use of mineral nitrogen fertilizer either urea or ammonium sulphate with FYM by the different ratios showed significantly greater value of harvest index compared with using mineral nitrogen fertilizer either urea or ammonium sulphate at full dose. The

highest value of harvest index was obtained in treatment receiving nitrogen from urea and FYM in 25:75 ratio in the first season, while the treatment receiving nitrogen from urea and FYM in 50:50 ratio gave the highest one in the second season.

Table (3):Grain yield, Straw yield and harvest index (%) of rice as affected by different sources of nitrogen fertilization in 2005 and 2006seasons.

Characters / Treatments(sources of nitrogen)	Grain yield (ton)\fed		Straw yield (ton)\fed		Harvest index (%)	
	2005	2006	2005	2006	2005	2006
Unfertilized treatment	2.69 c	2.29 c	2.67 c	2.38 d	47.3 abc	51.3 abc
Urea (46.5 % N)	3.54 ab	3.87 a	4.50 a	3.51 abc	43.0 de	47.0 e
Ammonium sulphate (20.5 % N)	3.36 abc	3.63 a	4.30 ab	3.89 ab	42.0 e	49.0 cde
Farm yard manure (FYM 1.3 % N)	2.97 bc	3.03 b	2.91 c	3.10 c	46.0 cd	49.0 b-e
Urea (25%) + FYM (75%)	3.03 bc	3.50 ab	3.24 bc	3.26 bc	50.0 a	47.3 de
A. sulphate (25%) + FYM (75%)	3.36 abc	3.43 ab	3.66 abc	3.69 abc	48.0 abc	50.0 a-d
Urea (50%)+ FYM (50%)	3.30 abc	3.60 a	3.50 abc	3.47 abc	47.0 abc	52.0 ab
A. sulphate (50%)+ FYM (50%)	3.51 ab	3.58 a	3.76 abc	3.38 bc	48.0 abc	52.7 a
Urea (75%) + FYM (25 %)	3.98 a	3.86 a	4.39 ab	4.10 a	49.3 ab	51.0 abc
A. sulphate (75%) + FYM (25 %)	3.86 a	3.77 a	4.22 ab	3.85 ab	46.3 bc	50.3 abc
Significance at 0.05 level	*	*	*	*	*	*

Means designated with the same letter (s) in the same column are not significantly different at 0.05 level of probability

It could be concluded from this study that organic materials alone could not completely substitute the chemical fertilizers to increase production but when applied with chemical fertilizers they enhanced the crop yield by increasing the use efficiency of applied chemical fertilizers.

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تأثير مصادر النيتروجين المعدنى و العضوى والتوافيق بينهما على محصول الأرز و مكوناتة.

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*** قسم المحاصيل-كلية الزراعة-جامعة القاهرة**

**** معهد البحوث و التدريب في الأرز بسخا- كفر الشيخ- مركز البحوث الزراعية**

لدراسة استخدام اليوريا او سلفات الأمونيوم اوا لسماد البلدى او التوافيق المختلفة من ا لسمادالبلدى مع اىَ منهما لزراعة صنف الأرز سخا ١٠٤ اجريت تجربتان حقليتان بمركز البحوث و التدريب فى الأرز بسخا – محافظة كفر الشيخ- مصر خلال موسمى ٢٠٠٥ ، ٢٠٠٦. وكان التصميم الستخدم القطاعات الكاملة العشوائية حيث احتوى كل قطاع على التوافيق المختلفة من مصادر النيتروجين ومعاملة الكنترول. اظهرت النتائج ان محصول الحبوب ومكوناتة و محصول القش قد زادت معنويا مع اضافة النيتروجين بالمقارنة بمعاملة عدم الأضافة. لايوجد فرق معنوى بين استخدام اليوريا او سلفات الأمونيوم على الصفات تحت الدراسة. استخدام السمادالبلدى بمفردة كمصدر للنيتروجين لم يوفر النيتروجين بكفاء عالية وذلك لانخفاض محتواه من النيتروجين بالأضافة لزيادة نسبة الكربون: النيتروجين.

وبصفة عامة فإن استخدام السماد المعدنى سواء اليوريا او سلفات الأمونيوم بنسبة ٧٥% من الجرعة الموصى بها واضافة ٢٥ % من السماد البلدى اظهر نفس الأستجابة عند استخدام الجرعة الموصى بها من السماد المعدنى سواء اليوريا او سلفات الأمونيوم.