CONTENTS

5. SUMMARY

The present investigation was conducted at Nubaria region in 2002/2003 and 2003/2004 seasons to define the role of agricultural machinery (land levelling methods and planting methods) to increase the yield of wheat, to decreasing utilization of chemical nitrogen fertilizer by using biofertilizer and organic manure might reduce financial costs, reduction environmental pollution and produce safe food and increasing net profit per feddan by increasing wheat yield and minimize total costs per feddan to increase cultivated areas of wheat.

Two fields experiments were carried out to investigate the effect of two land levelling methods (LASER and traditional), two planting methods (drilling and broadcasting) and seven treatments of fertilization as a combination of mineral nitrogen fertilizer, organic manure and biofertilizer. The experimental design was a split-split plot with four replicates, where the land levelling methods were assigned to the main plots; planting methods were allocated to the sub-plots, while fertilization treatments occupied the sub-sub plots. The pertinent results could be summarized in the following:

5.1. Agronomic characters

5.1.1. Plant height

LASER land levelling increases plant height comparing with the traditional land levelling. LASER land levelling increases plant height by 13.5 and 9.2% in 2002/03 and 2003/04 seasons, respectively. Plant height was significantly affected by planting method in both growing seasons. Drilling method of planting increases plant height by 17.2 and 14.9% in the first and second season, respectively. Plant height increases by 1.1, 16.5, 12.4, 8.5 and 5.8% in the first season and by 7.5, 16.3, 8.3, 7.6 and

7.1% in the second season for fertilization treatments F2, F4, F5, F6 and F7, respectively but F3 decreases plant height by 12.9 and 15.4 % in the first and second season, respectively as comparing with treatment F1.

5.1.2. Spike length

LASER land levelling produced longer spikes than traditional land levelling in both growing seasons. LASER land levelling increases spike length by 13.9 and 8.0% in 2002/03 and 2003/04 seasons, respectively. Drilling method of planting possessed longer spikes than broadcasting method in both seasons. Drilling method increases spike length by 20.2 and 10.5% in the first and second season, respectively. Spike length increased by 3.4, 20.7, 16.1, 9.2 and 5.7% in 2002/03 season and by 4.6, 18.4, 12.6, 10.3 and 2.3% in 2003/04 season for fertilization treatments F2, F4, F5, F6 and F7, respectively, but F3 decreased spike length by 13.8 and 14.9% in both seasons as compared with F1.

5.1.3. Number of tillers per plant

Land levelling methods had highly significant effect on number of tillers per plant in both seasons. LASER land levelling increases number of tillers per plant by 20.5 and 14.80% in the first and second season, respectively. Number of tillers per plant was 3.64 and 3.36 in drilling planting and 2.81 and 2.74 in broadcasting planting in the two seasons, respectively. Number of tillers per plant significantly affected by different fertilization treatments. The highest values of number of tillers per plant was recorded when wheat plants were fertilized by (100 kg N/fed +FYM + cerealin) and treatment (65 kg N/fed +FYM + cerealin) in the first and second seasons, respectively. The fertilization treatments F2, F4, F5, F6 and F7 increased number of tillers per plant by 2.7, 20.6, 18.3, 14.3 and 12.6%, respectively and F3 decreased number of tillers by 17.3% as compared with F1 in the first season. Whereas, in the second season F2

and F3 decreased number of tillers per plant by 23.0 and 0.4%, respectively, and the treatments F4, F5, F6 and F7 increased number of tillers per plant by 15.0, 16.4, 13.6 and 11.5%, respectively.

5.2. Physiological measurements

5.2.1. Flag leaf area

LASER levelling increases flag leaf area by 12.3 and 12.0% in 2002/03 and 2003/04 seasons, respectively. Drilling method of planting possessed larger flag leaf area than broadcasting method of planting in the first and second season. Drilling method increases flag leaf area by 19.5 and 19.1% in both seasons, respectively. The fertilization treatments F2, F4, F5, F6 and F7 increased flag leaf area by 4.8, 28.1, 24.1, 13.9 and 8.8% respectively, and F3 decreased this trait by 9.4% as compared with F1 in the first season, but in the second season the treatments F2, F4, F5, F6 and F7 increased flag leaf area by 4.0, 29.8, 13.9, 12.4 and 11.6%, respectively and F3 decreased flag leaf area by 13.0%.

5.2.2. Chlorophyll content

Chlorophyll content was highly significantly affected as a result of land levelling methods. Chlorophyll content was 43.40 and 42.36 mg/dm^2 with LASER land levelling and 38.57 and 38.19 mg/dm^2 with traditional land levelling in the first and second season, respectively. Chlorophyll content was 44.52 and 43.87 mg/dm^2 in drilling method of planting and 37.45 and 36.7 mg/dm^2 in broadcasting method of planting in the first and second season, respectively. The fertilization treatments F2, F4, F5, F6 and F7 increased chlorophyll content by 5.5, 28.3, 25.8, 17.0 and 10.4%, respectively and F2 decreased chlorophyll content by 5.5% in the first season, as compared with F1 (100kg N/fed). Also, the fertilization treatments F2, F4, F5, F6 and F7 increased chlorophyll content by 22.7,

38.0, 39.0, 30.7 and 20.5%, respectively and F2 treatment decreased chlorophyll content by 5.1% in the second season as compared with F1.

5.2.3. Grain protein content

The highest value of protein content produced by LASER levelling in the first and second season. LASER land levelling increases protein content by 2.74 and 3.54% in 2002/03 and 2003/04 seasons, respectively as compared with traditional land levelling. Drilling method of planting increases protein content by 1.9 and 2.7% in the first and second season, respectively. The fertilization treatment F2, F4, F5, F6 and F7 increased protein content by 0.63, 8.42, 6.00, 6.72 and 4.21%, respectively, and treatment F3 decreased protein content by 6.18% as compared to F1 (100 kg N/fed) in the first season. Also, in the second season, fertilization treatments F2 and F3 decreased protein content by 0.52 and 8.53%, respectively, and fertilization treatments F4, F5, F6, and F7 increased protein content by 8.88, 5.92, 7.14 and 4.26%, respectively.

5.2.4. Nitrogen use efficiency (NUE)

LASER land levelling increased NUE by 12.6 and 16.8% compared with traditional land levelling in the first and second season, respectively. Nitrogen use efficiency was 36.1 and 35.3 kg grain / kg N with drilling method of planting and 31.1 and 29.1 kg grain / kg N with broadcasting method in both seasons, respectively. Fertilization treatments F2, F3, F4, F5, F6 and F7 were increased NUE by 1.9, 22.6, 12.6, 69.6, 5.6 and 58.1%, respectively for the first season and by 3.8, 16.3, 13.3, 65.0, 5.3 and 53.2%, respectively for the second season.

5.2.5. Crop growth rate (CGR)

5.2.5.1. CGR at 60 - 90 days after sowing

LASER land levelling increased CGR at 60 - 90 DAS by 21.9 and 21.5% as compared with traditional land levelling in the first and second

season, respectively. Drilling method increased CGR at 60 - 90 DAS by 16.7 and 18.3% as compared with broadcasting method in the first and second season, respectively. The fertilization treatments F2, F4, F5, F6 and F7 increased CGR at 60 - 90 DAS by 3.2, 18.3, 14.2, 10.6 and 8.9%, respectively and F3 decreased CGR at 60 - 90 DAS by 10.0% as compared with F1 (100 kg N/fed) in the first season. The fertilization treatments F2, F4, F5, F6 and F7 increased CGR at 60 - 90 DAS by 1.2, 20.1, 17.4, 11.3 and 7.4%, respectively and F3 decreased CGR at 60 - 90 DAS by 13.0% as compared with F1 (100 kg N/fed) in the second season.

5.2.5.2. CGR at 90 - 120 days after sowing

CGR at 90 - 120 DAS increased after land was levelled by LASER by 14.5 and 13.1% as compared with traditional land levelling in 2002/03 and 2003/04 seasons, respectively. The drilling method increased CGR at 90 – 120 DAS by 19.0 and 26.0% in 2002/03 and 2003/04 seasons, respectively as comparing with the broadcasting method of planting. Fertilization treatments F2, F4, F5, F6 and F7 increased CGR at 90 - 120 DAS by 9.0, 52.5, 38.6, 30.1 and 28.4%, respectively and F3 decreased CGR at 90 - 120 DAS by 24.9% as compared with F1 in the first season. While, in the second season, fertilization treatments F2, F4, F5, F6 and F7 increased CGR at 90 - 120 DAS by 9.5, 50.2, 43.9, 22.3 and 21.9%, respectively and F3 decreased CGR at 90 - 120 DAS by 23.9%.

5.2.6. Relative growth rate (RGR)

5.2.6.1. RGR at 60 - 90 days after sowing

LASER land levelling increased RGR at 60 - 90 DAS by 5.0 and 7.3% in the first and second season, respectively as compared with traditional land levelling. RGR at 60 - 90 DAS was 0.041 and 0.043 g/g/day with drilling method and 0.041 and 0.042 g/g/day with broadcasting method of planting in 2002/03 and 2003/04 seasons,

respectively. There is non-significant difference between the treatments F1, F2 and F3 and possessed the highest value of RGR at 60 - 90 DAS in both seasons, also, the treatments F4, F5, F6 and F7 have non-significant difference between them in the two seasons.

5.2.6.2. RGR at 90 - 120 days after sowing

Precession land levelling by using LASER control equipments and traditional land levelling by scraper have the same value (0.020 g/g/day) of RGR at 90 - 120 DAS in the first and second season. Wheat plants were planted by grain-drill increased the RGR at 90 - 120 DAS by 5.0 and 10.0% as compared with broadcasting method of planting in 2002/03 and 2003/04 seasons, respectively. The fertilization treatments F2, F4, F5, F6 and F7 increased RGR at 90 - 120 DAS by 5.3, 21.1, 15.8, 10.5 and 10.5%, respectively and F2 decreased by 10.5% as compared with F1 (100 kg N/fed) in 2002/03 season. Whilst, fertilization treatments F2, F4, F5, F6 and F7 increased RGR at 90 - 120 DAS by 5.0, 15.0, 10.0, 5.0 and 10.0%, respectively and F2 decreased RGR at 90 - 120 DAS by15.0% in 2003/04 season.

5.3. The yield and yield components

5.3.1. Number of spikes/m^2

LASER land levelling increased number of spikes/m^2 by 15.2 and 17.05% as compared with traditional land levelling for the first season and second season, respectively. Drilling method of planting increased number of spikes/m^2 by 20.3 and 21.9% for the first and second season, respectively as compared with broadcasting method of planting. The fertilization treatments F2, F4, F5, F6 and F7 significantly increased number of spikes/ m^2 by 1.9, 14.6, 11.9, 10.4 and 7.5%, respectively and F2 decreased number of spikes/ m^2 by 0.4% as compared with F1 (100 kg N/fed) in the 2002/03 season. Also, in 2003/04 season, fertilization

treatments F2, F4, F5, F6 and F7 significantly increased number of spikes/ m^2 by 1.8, 14.8, 16.8, 10.5 and 8.1%, respectively and F2 decreased number of spikes/ m^2 by 0.5% as compared with F1 (100 kg N/fed).

5.3.2. Number of kernels per spike

LASER land levelling increased number of kernels per spike by 14.7 and 14.9% in 2002/03 and 2003/04 seasons, respectively as compared with traditional land levelling. The planting by grain-drill increases number of kernels per spike by 17.0 and 19.7% in 2002/03 and 2003/04 seasons, respectively as compared with broadcasting method of planting. The fertilization treatments F2, F4, F5, F6 and F7 increases number of kernels per spike by 3.4, 25.2, 21.8, 14.5 and 11.1%, respectively and F2 decreased number of kernels per spike by 11.8% as compared with F1 (100kg N/fed) treatment in the first season. The fertilization treatments F2, F4, F5, F6 and F7 increases number of kernels per spike by 0.4, 25.8, 22.5, 10.8 and 11.0%, respectively and F2 decreased number of kernels per spike by 12.4% as compared with F1 (100kg N/fed) treatment in the second season.

5.3.3. 1000-kernel weight

LASER land levelling increased 1000-kernel weight by 15.4 and 12.5% in the first and second season, respectively as compared with traditional land levelling. Drilling method of planting increased 1000-kernel weight by 21.4 and 17.6% as compared with broadcasting method of planting in the first and second season, respectively. The fertilization treatments F2, F4, F5, F6and F7 increases 1000-kernel weight by 1.9, 17.2, 12.9, 8.0 and 5.2%, respectively and F3 decreases 1000-kernel weight by 9.2% as compared with F1 (100kg N/fed) in the first season. The fertilization treatments F2, F4, F5, F6 and F7 increases 1000-kernel

weight by 2.9, 18.7, 16.4, 12.6 and 5.7%, respectively and F3 decreases 1000-kernel weight by 4.5% as compared with F1 (100kg N/fed) in the second season.

5.3.4. Grain yield

LASER land levelling increased grain yield by 12.8 and 16.8% in the first and second season, respectively. Wheat planting by grain-drill increases grain yield by 16.5 and 21.8% as compared with broadcasting method in the first and second season, respectively. The fertilization treatment F2, F4, F5, F6 and F7 increased grain yield by 1.9, 12.6, 10.4, 5.6 and 3.0%, respectively and F3 decreased grain yield by 20.4% as compared to F1 (100 kg N/fed) in the first season. The fertilization treatment F2, F4, F5 and F6 increased grain yield by 3.8, 13.3, 7.2 and 5.3%, respectively and treatments F3 and F7 decreased grain yield by 24.3 and 0.4%, respectively as compared to F1 in the second season.

5.3.5. Straw yield

LASER levelling increased straw yield by 10.7 and 10.2% as compared with traditional land levelling in the first and second season, respectively. Drilling method of planting increased straw yield by 7.0 and 7.8% as compared with broadcasting method in the first and second season, respectively. The fertilization treatments F2, F4, F5, F6 and F7 increased straw yield by 3.6, 15.5, 12.3, 9.1 and 5.7%, respectively and F3 decreased straw yield by 4.2% as compared with F1 in the first season. The fertilization treatments F2, F4, F5, F6 and F7 increased straw yield by 3.9, 16.6, 12.9, 8.4 and 7.6%, respectively and F3 decreased straw yield by 2.3% as compared with F1 (100kg N/fed) in the 2003/04 season.

5.3.6. Harvest index

LASER land levelling increased harvest index by 0.9 and 3.8% as compared with traditional land levelling in the first and second season,

respectively. Drilling method of planting increases harvest index percent by 5.3 and 8.3% in the first and second season, respectively. There is non-significant difference between treatments F1, F2, F3, F4, F5 and F6 in the first season and F1, F2, F4 and F6 in the second season.

5.4. Economic analysis

5.4.1. Total costs of wheat production

The treatment (LASER levelling + broadcasting planting + 100 kg N/fed + FYM + cerealin) (T18) possessed the highest total costs and treatment (traditional levelling + drilling planting + 100 kg N/fed) (T8) has the lowest total costs.

5.4.2. Net profit

The treatment (LASER land levelling + drilling method of planting + 100 kg N/fed + cerealin) (T27) possessed the maximum net profit in both seasons and the minimum net profit recorded by treatment (traditional land levelling + broadcasting method of planting + 65 kg N/fed + FYM) (T3).

..., ... yield components increases and then the grain and straw yields increases.

- Planting by grain drill increases grain and straw yields as a result of increasing agronomic characters and physiological measurements and then increases yield components.
- Biofertilizer has affective role to improve all characters under this study and increases grain and straw yields.
- Using biofertilizer decreases utilization of mineral nitrogen fertilizer and reduces financial costs, and reduction environmental pollution.
- Organic manure has a little effect to increase grain and straw yields comparing with biofertilizer effect and increases effectiveness of biofertilizer.
- Using of agricultural machinery increases net profit at no extra costs.
- The interactions between studied factors have a magnificent effect to increase grain yield.

Recommendations

- It is necessary to use agricultural machinery to increase the yields and reduced financial production costs and thus increases net profit.
- Biofertilizers must be used to improve the fertility of newly reclaimed lands and reduced utilization of nitrogen mineral fertilizers, which lead to environment pollution and produced unsafely foods.