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# Effect and aftereffect of mineral fertilizers on the yield of winter wheat as main crop and millet and mung bean as stubble crops

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## Abstract

In low-fertile irrigated lands in the southern region of Uzbekistan, the use of increased norms and the ratio of mineral fertilizers can double the yield of grain with the year-round use of irrigated land in the system of two crops per year.

By applying increased norms and ratios of the annual norm of mineral fertilizers to the main crop of winter wheat, along with an increase in the yield of the main crop, the yield of next crops increased too, due to the residues of mineral fertilizers in the soil, in comparison with control variants of the experiment where NPK was not applied to the main crop of winter wheat. At the same time, the grain yield of main crop of winter wheat and this of the next stubble crops of millet and mung bean raised up to 1.5-2.0 times by the effect and aftereffect of mineral fertilizers.

**Key words**: winter wheat; millet; mung bean; stubble crops; mineral fertilizers; irrigation

Soil climatic conditions in the southern regions of Uzbekistan are characterized by a length of vegetative period that allows growing 2-3 crops a year (Babushkin, 1981; Irnazarov, 2000; Irnazarov, 2002). However, when growing 2-3 crops within one year, problems associated with soil fertility arise more sharply, which dictates optimum supply of crops with nutrients during the year-round use of the irrigated land region (Gasanov and Mamedguseinov, 1972).

This problem became even more acute with the acquisition of grain independence of Uzbekistan when part of the irrigated land was allocated for the cultivation of winter wheat, which displaced alfalfa from the cotton complex system and the cotton seedlings were alternating with winter wheat, which was further enhanced by the deterioration of soil fertility in which rational use dictates mineral fertilizers when growing two grain crops a year (Gavrilov, 1985; Ismailov et al., 2006; Khalilov, 1992).

In connection with this, our research task included solutions to the problem of increasing the effectiveness of low-fertility irrigated lands through the year-round use of such lands in the system of growing two grain crops per year by the action and aftereffect of mineral fertilizers.

## Materials and Methods

Field experiments were conducted in 2012-2014 on the farm "Kulmanov Umir", Kasan district with winter wheat variety Krasnodar-99 at four short replicates. The plot size was 180 m2 and the registration plot was 100 m2. Field experiments and other studies were carried out according to Dospekhov's methods (Dospekhov, 1985).

Annual rates of phosphorus and potassium fertilizers were applied with sowing of winter wheat according to the variant of the experiment. Nitrogen fertilizers were applied in the stage of spring tillering (35%), at the beginning of the tube (35%) and in the stage of earing (30%).

After harvesting, the winter wheat stubbles were

plowed and an additional irrigation was carried out with the norm of 1200 $m^3$/ha. At sixth day, the spreading of mung bean seeds with the norm of 30 kg/ha was carried out and furrows with inter-row 60 cm were shaped. After full germination of the mung bean seeds, irrigation with a norm of 500 $m^2$/ha was carried out. The second watering was carried out during the pod formation also at a rate of 500 $m^3$/ha. The harvest of the mung bean was carried out at the end of September.

When sowing millet, the stubble of winter wheat was also plowed with sliced 60 cm furrows. We sowed millet seeds in scattered ways at 20 kg/ha and irrigation at a rate of 800 $m^3$/ha. Before flowering millet, one-time watering was carried out with a rate of 500 $m^3$/ha. The harvest of millet was carried out on mid-September.

In addition to the repetitions of the experiment variants, there was 1 $m^2$ control area, where grain yield of winter wheat was determined, repeated sowing of millet and mung bean.

**Results and Discution**

As the results of our studies showed the increase in the norm and the ratio of mineral fertilizers used in topping up winter wheat grown as the main crop with year-round use of irrigated land in the system of growing two grain crops a year, there was natural increase in the grain yield both in the main crop of winter wheat and in second crops of millet and mung bean (Table 1).

**Table 1**. Effect and effectiveness of mineral fertilizers on the yield of winter wheat and second crops (average data for 2012-2014)

| № | Indicators / Variants | Effect of mineral fertilizers on the yield of winter wheat grain | | Effectiveness of mineral fertilizers on grain productivity of second crops | | | |
|---|---|---|---|---|---|---|---|
| | | | | Millet | | Mung bean | |
| | | c/ha | difference, +- | c/ha | difference, +- | c/ha | difference, +- |
| 1 | Without NPK (st1) | 35,8 | 0 | 12,4 | 0 | 10,5 | 0 |
| 2 | $N_{150}P_{75}K_{50}$ | 58,9 | +23,1 | 18,3 | +5,9 | 12,5 | +2,0 |
| 3 | $N_{180}P_{90}K_{60}$ (st2) | 67,3 | +31,5 | 20,8 | +8,4 | 13,9 | +3,4 |
| 4 | $N_{210}P_{105}K_{70}$ | 71,3 | +35,5 | 22,5 | +10,1 | 15,8 | +5,3 |
| 5 | $N_{210}P_{120}K_{80}$ | 75,9 | +40,1 | 24,0 | +11,6 | 17,5 | +7,0 |
| 6 | $N_{210}P_{135}K_{90}$ | 77,3 | +41,5 | 25,6 | +13,2 | 18,6 | +8,1 |
| 7 | $N_{210}P150K_{100}$ | 80,4 | +44,6 | 27,8 | +15,4 | 19,2 | +18,7 |

The effect of mineral fertilizers on the yield of winter wheat increased from 23.1 centner/ha to 44.6 centner/ha in comparison with the control varieties of the experiment where NPK was not applied. However, it should be noted that a regular increase in the grain yield is observed before the increase in the norm and the ratio of mineral fertilizer to the limit of increase to $N_{210}P_{135}K_{90}$ and $N_{210}P_{150}K_{100}$. And further increases in the grain yield of winter wheat are only 4.5 c/ha in comparison with the options for the experiment where the increase in mineral fertilizers was $N_{210}P_{120}K_{80}$.

In effectiveness of mineral fertilizers, the increase in the yield of millet grain was also regular with the norm and the ratio of mineral fertilizers applied for the main crop of winter wheat. In this case, the increase in millet grain was from 5.9 c/ha to 15.4 c/ha. Therefore, these data allow us

to believe that doubling the norm and the ratio of mineral fertilizers will also double the yield of grain of millet after the remnant of mineral fertilizers in the soil.

As noted above, with the year-round use of irrigated land in the system of growing two grain crops per year, soil fertility deteriorates. In connection with this, in our experiments we used leguminous mung bean (Asiatic pea) as a stubble second crop to raise soil fertility by accumulating up to 100 kg/ha of organic nitrogen and other organic residues with the help of which, along with soil enrichment, the structure of irrigated land improves (Gasanov and Mamedguseinov, 1972; Irnazarov, 2000; Khalilov, 1992). It has also been established that with the increasing of grain yield, the nodule bacteria developing on the root are increasing, which play an important role in improving the fertility of irrigated lands (Gavrilov, 1985; Irnazarov, 2002).

In stubble cultivation of mung bean after residues in the soil of mineral fertilizers in which the growing of winter wheat as the main crop in the system of growing two crops per year, the increasing of grain yield was from 2.0 c/ha to 8.7 c/ha. However, the fluctuation of the additional grain yield may be a mistake of experience in the redistribution of permissible errors in which the limits are not exceeded to 1.9 centner/ha.

Thus, the use of mung bean as stubble crop after winter wheat contributed to the increase of soil fertility in the system of growing two grain crops a year.

## Conclusion

For rational use of irrigated land in the southern regions of Uzbekistan and for increasing of effectiveness of mineral fertilizers, the use of aftereffects of mineral fertilizers played decisive role by applying the annual rate of mineral fertilizers at the main crop of winter wheat in the system of growing two grain crops a year, at which the total grain yield raised to 1.5-2.0 times.

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