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***Dragoljub MITROVIĆ and Radisav DUBLJEVIĆ*** [1]

# EFFECTS OF APPLICATION OF DIFFERENT MINERAL FERTILIZERS AND CULTIVATION METHODS ON POTATO YIELD

## SUMMARY

Planting, fertilizing and cultivation are important agro-technical operations in potato production which, to a large extent, have effect on yield and cost-effectiveness of production.

This paper presents the results of the research of factors that influenced potatoes yield. Potato planting was done with a two-row automatic planter with the towing-propulsion 30 kW engine. A device for precise fertilizer dispensing was attached to the planter in order to spread fertilizer into the soil during planting in line with the analysis method determined. Cultivation of potato crops, stirring up and hilling was done with the three-row cultivator with the towing-propulsion engine of 30 kW.

Average potato yield of 25.58 t/ha was achieved in the variant (B), with application of mineral fertilizer in the quantity of 500 kg in pre-planting soil preparation and another 500 kg during planting with the dispenser, with crop cultivation (stirring up, hilling). In the variant (A), where fertilizer was applied in the quantity of 1000 kg/ha in pre-planting soil preparation, without application of fertilizer during planting, the average potato yield of 22.82 t/ha was achieved. In the variant (C), fertilizer was applied during planting (direct application) in the quantity of 500 kg/ha, and average potato yield was 20.29 t/ha.

Research results justify potato cultivation as well as direct application of mineral fertilizer during planting.

**Keywords:** mechanization, planting, cultivation, fertilizer, yield.

## INTRODUCTION

Potato production is very specific, as a result of natural technological, economic, sociological and other factors. Lately, potato production has become very important, not only because of increase in food demand, but also because its production is cost-effective. As a result of use of new high-yield varieties, agro-technical measures applied and use of machinery, the yields per area have increased as well as quality in terms of nutrient content (Maksimović, P. 1996).

Application of mineral fertilizers and inter-row cultivation are important agro-technical measures in potato production. In the technological production process, inter-row cultivators are used for inter-row cultivation, which are

[1] Dragoljub Mitrović (corresponding author: drd_mitrovic@yahoo.com), Radisav Dubljević, Biotechnical faculty, University of Montenegro, M. Lalića, 1, Podgorica, Montenegro.

equipped with the fertilizer and soil insecticide dispenser for application at a specific depth, from one or another side of the plant (Lilo. M., 1976).

Granulated mineral fertilizer can be applied during planting, by attaching the device for precise application, in line with the determined quantity per area.

The purpose of the research is to analyse the application of machinery and devices and their effects on potato cultivation and application of mineral fertilizers in different variants during planting and their effect on potato yields.

## MATERIAL AND METHODS

The research, in line with the method of work set, was conducted in the area of Krnovo, Municipality of Nikšić, in 2006. A production area of 0.55 ha was selected for machinery research and potato variety Kennebec, reproduction of the original, was selected as planting material. The planting was done at the inter-row distance of 75 cm and distance between the plants in a row was 30 cm. average seed quantity was about 3365 kg/ha. Application of mineral fertilizer NPK=8:16:24, was done in different variants: A=(1000 kg/ha); B=(500 kg/ha + 500 kg/ha) and C=(500 kg/ha), in line with the research method set.

The following towing machinery, attachments and devices were used in the research programme: Tractor Universal 45, 34 kW; Tractor IMT 539, 29 kW; Rototiller m.f. 1600, r.z.,1.6 m.; Seeder Imt, r.z, 3.2 m.; Tow behind NPK dispenser, V=300 l; Two-row automatic potato planter, ADR-2; Inter-row cultivator with three rows (three-row), ANJ; Tow behind crop sprayer, V=450 l.


Figure 1. Two-row automatic potato planter with fertilizer dispenser

A device (depositor) for precise application of mineral fertilizers was attached to the automatic potato seeder in order to apply fertilizers in the quantity as set by the research method set.

A production area of 616 $m^2$ (110 m x 5.6 m) was selected for machinery research. The research by variants, as set by the established methodology, was conducted on a production area (test plot) of 154 $m^2$ (110 m x 1.4 m).

Variant (A): Application of mineral fertilizer (NPK= 8:16:24) in pre-planting soil preparation in the quantity of 1000 kg/ha. Potato cultivation: (stirring up) and variant (stirring up and hilling).

Variant (B): Application of mineral fertilizer (NPK=8:16:24) in pre-planting soil preparation in the quantity of 500 kg/ha and 500 kg/ha of mineral fertilizer during planting. Potato cultivation: (stirring up) and variant (stirring up and hilling).

Variant (C): Application of mineral fertilizer (NPK=8:16:24) during planting (into the furrow) in the quantity of 500 kg/ha. Potato cultivation: (stirring up) and variant (stirring up and hilling).

The technical production rate was set on the basis of the following equation: Wt = 0,1. b. v. n (ha/h)

In order to test the significance of differences of means for the parameters tested, the t test was used t = test: (te < tt 0.05), difference not statistically significant; (tt 0.05 <te < tt 0.01) difference is statistically significant (*) ; (te > tt 0.01) the difference is highly statistically significant (**).

## RESULTS AND DISCUSSION

Potato cultivation is an important technological operation that mechanically destroys weeds, breaks the soil crust, loosens the soil and banks up soil layer. The mounted three-row inter-row cultivator on a propulsion engine of 29 kW was used in this research.

Table 1. Results of machinery testing in potato cultivation.

| Machinery round | Working speed of the engine (km/h) | Fuel consumption (l/h) | Fuel consumption (l/ha) | Power consumption (MJ/ha) | Plant damaged (%) | Technical production rate (ha/h) |
|---|---|---|---|---|---|---|
| I | 4.1 | 3.6 | 5.8 | 238.00 | 5 | 0.62 |
| II | 3.9 | | 6.21 | 255.00 | 7 | 0.58 |
| III | 3.58 | | 6.70 | 275.00 | 4 | 0.54 |
| IV | 4.20 | | 5.63 | 231.00 | 12 | 0.64 |
| $X_{SR}$ | 4.00 | 3.6 | 6.1 | 250.00 | 7 | 0.60 |

The results of exploitation and techno-economic research of machinery used in inter-row cultivation of potato are presented in the Table 1.

The average working speed of the engine in inter-row cultivation of potato crops was 4.0 km/h. In inter-row cultivation, the percentage of damaged potato plants ranged from 4 - 12 %. The technical production rate of the engine under research ranged from 0.54 ha/h – 0.64 ha/h.

Potato yield achieved in the plot under research in the variant A, were presented in the Table 2.

Table 2. Potato yield achieved at the specific plot in the variant (A).

| Machinery round | Plot area ($m^2$) | Potato yield achieved | | | |
|---|---|---|---|---|---|
| | | Hilling | | Stirring up and hilling | |
| | | kg/plot | kg/ha | kg/plot | kg/ha |
| I | 154 | 315 | 20,454 | / | / |
| II | 154 | 330 | 21,428 | / | / |
| III | 154 | / | / | 341 | 22,142 |
| IV | 154 | / | / | 362 | 23,506 |
| $X_{sr}$ | 154 | 322 | 20,941 | 351 | 22,824 |

In the variant A, with application of mineral fertilizer NPK=8:16:24 in the pre-planting soil preparation of 1000 kg/ha, the average potato yield in the variant (hilling) was 20.94 t/ha. In the variant (stirring up and hilling) average potato yield was 22.82 t/ha which produces an absolute difference of 1.88 t or increase by 8.25 %.

Table 3. Potato yield achieved at the specific plot in the variant (B).

| Machinery round | Cultivated plot area ($m^2$) | Potato yield achieved | | | |
|---|---|---|---|---|---|
| | | Hilling | | Stirring up and hilling | |
| | | kg/plot | kg/ha | kg/plot | kg/ha |
| I | 154 | 372 | 24,156 | / | / |
| II | 154 | 380 | 24,675 | / | / |
| III | 154 | / | / | 403 | 26,169 |
| IV | 154 | / | / | 385 | 25,000 |
| $X_{sr}$ | 154 | 376 | 24,415 | 394 | 25,584 |

The potato yield achieved in the variant B, with application of mineral fertilizer NPK=8:16:24 in the quantity of 500 kg/ha in the pre-planting soil preparation and 500 kg/ha of mineral fertilizer NPK=8:16:24 during planting is given in the Table 3.

In the variant (B) with hilling, average potato yield was 24.41 t/ha. In the variant (stirring up and hilling) average potato yield achieved was 25.58 t/ha, which is an increase of 1.17 t/ha, or by 4.8%.

The potato yield achieved in the variant C, with introduction of mineral fertilizer NPK=8:16:24 during planting in the quantity of 500 kg/ha is presented in the Table 4 below.

Table 4. Potato yield achieved at the specific plot in the variant (C).

| Machinery round | Cultivated plot area ($m^2$) | Potato yield achieved | | | |
|---|---|---|---|---|---|
| | | Hilling | | Stirring up and hilling | |
| | | kg/plot | kg/ha | kg/plot | kg/ha |
| I | 154 | 305 | 19,805 | / | / |
| II | 154 | 300 | 19,480 | / | / |
| III | 154 | / | / | 310 | 20,130 |
| IV | 154 | / | / | 315 | 20,454 |
| $X_{sr}$ | 154 | 302.5 | 19,642 | 312.5 | 20,292 |

Table 5. Absolute and relative differences in potato yield in the hilling variant.

| Variant | Absolute difference (kg) | Relative difference % |
|---|---|---|
| A : B (322.5 : 376.0) | 53.5 ** | 16.60 |
| A : C (322.5 : 302.5) | 20.0 | 6.20 |
| B : C (376.0 : 302.5) | 73.5 ** | 19.50 |

Table 6. Absolute and relative differences in potato yield in variant (hilling and stirring up)

| Variant | Absolute difference (kg) | Relative difference % |
|---|---|---|
| A : B (351.5 : 394.0) | 42.50 * | 12.00 |
| A : C (351.5 : 312.5) | 39.00 | 11.00 |
| B : C (394.0 : 312.5) | 81.50 ** | 20.70 |

In the variant hilling, average potato yield was 19.642 t/ha. In the variant (stirring up and hilling) average potato yield was 20.292 t/ha, which is an increase in yield for 0.640 t/ ha, or by 3.20 %.

Absolute and relative differences in values of parameters under research are given in the Table 5.

## CONCLUSIONS

–The highest potato yield of 25.58 t/ha was achieved in the variant B, with application of fertilizer NPK=8:16:24 in the quantity of 500 kg/ha, in pre-planting soil preparation and application of fertilizer NPK=8:16:24 in the quantity of 500kg/ha, during planting and cultivation (stirring up + hilling).

–The potato yield of 24.41 t/ha achieved in the variant B, with one hilling, is higher by 16.6 % compared to variant A, with achieved yield of 20.94 t/ha.

–The potato yield of 24.41 t/ha achieved in the variant B, with one hilling, is by 19.5% higher than in the variant C, with the yield of 19.64 t/ha, where mineral fertilizer NPK=8:16:24 was applied in the quantity of 500 kg/ha during planting.

–In the variant B, with application of mineral fertilizer NPK=8:16:24 in the quantity of 500 kg/ha in the pre-planting soil preparation and 500 kg/ha during planting, as well as with inter-row cultivation (stirring up and hilling), the potato yield achieved was 25.58 t/ha. The yield achieved is by 12 % higher compared to the variant A, of 22.82 t/ha, and by 20.70 % higher compared to the variant C, with achieved yield of 20.29 t/ha.

–The depositor device mounted on the two-row automatic plant ADR-2, is a conceptual solution that enables dosage of granulated mineral fertilizer and soil insecticide per area, in line with the projected quantity per area

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*Dragoljub MITROVIĆ i Radisav DUBLJEVIĆ*

## UTICAJ PRIMJENE RAZLIČITIH VARIJANTI MINERALNOG ĐUBRIVA I KULTIVACIJE NA PRINOS KROMPIRA


### SAŽETAK

U proizvodnji krompira sadnja, đubrenje i kultivacija predstavljaju važne agrotehničke operacije od kojih u velikoj mjeri zavisi prinos i ekonomičnost proizvodnje.

U radu su prikazani rezultati istraživanja koji su uticali na prinos krompira. Sadnja krompira je obavljena sa dvorednom automatskom sadilicom u agregatu vučno pogonske mašine od 30 kW. Na sadilici je postavljen uređaj za precizno unošenje mineralnog đubriva u zemljište prilikom sadnje prema utvrđenom metodu ispitivanja. Kultivacija usjeva krompira, okopavanje i nagrtanje obavljeno je sa trorednim kultivatorom u agregatu vučno pogonske mašine od 30 kW.

Kod varijante (B) primjenjeno je mineralno đubrivo u količini od 500 kg/ha u predsjetvenoj pripremi zemljišta i 500 kg/ha u sadnji sa depozitorom i kultivacijom usjeva (okopavanje+nagrtanje), a ostvaren je prosječan prinos krompira od 25,58 t/ha.

Kod varijante (A) primjena mineralnog đubriva u količini od 1000 kg/ha u predsjetvenoj pripremi zemljišta, bez unošenja đubriva prilikom sadnje, ostvaren je prosječan prinos kromira od 22,82 t/ha.

Kod varijante (C) primjena mineralnog đubriva prilikom sadnje (direktnim unošenjem) u količini od 500 kg/ha, ostvaren je prosječan prinos krompira od 20,29 t/ha.

Rezultati istraživanja ukazuju na opravdanost kultivacije krompira kao i direktnog unošenja mineralnog đubriva prilikom sadnje.


**Ključne riječi**: mehanizacija, sadnja, kultivacija, mineralno đubrivo, prinos