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BLACK CURRANT PRODUCTIVITY FORMATION AS AFFECTED BY THE COMPONENTS OF CULTIVATION TECHNOLOGY

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ABSTRACT

Studied in the experiment were the following components of cultivation technology for black currant: maintaining the soil between rows as black fallow or grassed; maintaining the rows as black fallow, mulched with straw or covered with polyethylene mulch film; foliar dressing in the budding stage with liquid suspended organic fertiliser Riverm at the concentrations of 1, 3 or 5% against the background of complete mineral fertiliser $N_{60}P_{90}K_{90}$. According to the results of the research, it was found that the best growth and development of black currant plants was for maintaining the soil between rows as black fallow and maintaining the rows mulched with straw. Such practices activate the soil microbiota and facilitate the availability of nutrients to plants. Mulching with straw effectively protects against weeds, prevents damage to plants by tillage tools, and does not prevent rainfall from entering the soil. Accordingly, the best indicators of the maximum number of bunches of black currant (604) fruit number per bush (1315) were obtained in the treatment with maintaining the rows as black fallow and the use of fertiliser $N_{60}P_{90}K_{90}$ (background) + Riverm 5 %. However, the highest fruit weight (1.66−1.74 g) was obtained in the treatment with maintaining the soil between rows as black fallow, the use of fertiliser background $N_{60}P_{90}K_{90}$ + Riverm 3 % or Riverm 5 %. In general, the use of mineral fertilisers along with foliar dressing using Riverm increased the fruit yield in the treatment with $N_{60}P_{90}K_{90}$ + Riverm 3 % under maintaining the rows as black fallow and mulching the rows using the straw up to 13.44 t/ha; for the use of Riverm 5 %, the fruit yield was 13.28 t/ha.

Keywords: number of bunches, bunch length, number of berries, the weight of berries

INTRODUCTION

Black currant possesses many valuable economic and biological characteristics and can provide a quite early production of berries. According to economic characteristics, black currant is a winter-hardy, fast-fruiting, highly productive berry crop with a high content of vitamins, and is quite well adapted for growing in Ukraine. However, despite the high level of productivity, it is not always possible to obtain good results in production conditions, which is due not only to the adaptation of several components of cultivation technology but a comprehensive approach to the provision of the conditions necessary for successful fruiting of currant (Bratsch, Williams. 2009; Davis *et al.*, 2012).

Fertilisers are a prerequisite for stable, highly productive agro ecosystems, which is especially important for perennial crops. After all, after the application of fertilisers, the lack of basic nutrients can be compensated, and any mistakes in the application of fertilisers to perennial crops lead to a low level of productivity of plantations during the years of growing. And only the use of fertilisers in optimal proportions along with other agronomic measures is the basis not only for obtaining a high level of currant productivity but also for maintaining soil fertility (Harmat *et al.*, 1990; Toldam-Andersen, Hansen, 1993; Kim *et al.*, 2011; Djordjevic *et al.*, 2014).

Currant is capable of forming different levels of productivity. For example, 4−7 t/ha is considered low, while the optimum yield is above 10 t/ha (Jordan, Warner, 2010; Lovell, Johnston 2009; Gallagher *et al.*, 2015). In general, in the conditions of Ukraine, it is quite possible to obtain the yield of black currant in the range from 9.3 to 11.4 t/ha, which provides high profitability. Accordingly, the study of improving the components of cultivation technology aimed at obtaining high yield and quality of the products is a very important issue (Shevchuk *et al.*, 2011; Kopytko *et al.*, 2017).

The purpose of our research was to determine the peculiarities of the yield structure formation in black currant under the effect of fertilisers and various methods of soil maintenance in rows and between rows.

MATERIALS AND METHODS

The research was carried out in the Training, Research, and Production Department of Uman National University of Horticulture in blackcurrant plantations in the years 2017–2019. The black currant variety under study was ‘Siuita Kyivska’. It had been growing in the site since 2012. The soil of the research plots was podzolic heavy loam

chernozem on loess. The humus content in the arable soil layer was 3.2–3.3%; the degree of alkali saturation was in the range from 90 to 93%; the reaction of the soil solution was slightly acidic (pH_{sal} 5.5); hydrolytic acidity was 1.9–2.3 cmol/kg of soil; the content of mobile compounds of phosphorus and potassium (by the Chirikov's method)was 100–120 mg/kg and the nitrogen of alkaline hydrolyzed compounds (by the Cornfield's method) 100–110 mg/kg of soil (Ermantraut *et al.*, 2014).

Cultivation technology for currant was typical for the Right-Bank Forest-Steppe of Ukraine. In the experiment, we used ammonium nitrate, granular superphosphate, and potassium chloride for fertilisation. Phosphorus and potassium fertilisers were applied under the main tillage to the root zone, while nitrogen was applied before the beginning of spring vegetation (Tkachyk *et al.*, 2016). The experiment design included treatments with soil maintenance between rows under bare fallow and grassing, in rows under bare fallow, mulching with straw and film, and foliar fertilisation with liquid suspended organic fertiliser Rivermat the concentrations of 1, 3 and 5% applied in the budding stage against the background $N_{60}P_{90}K_{90}$. The planting design for currant bushes was 3 m × 0.5 m with 3 replications.

RESULTS AND DISCUSSION

The studies to determine the biometric characteristics of a bunch of black currant showed that the lowest number of bunches per bush and the lowest length of the bunch were observed in the control treatments of the experiment

Table 1. Biometric characteristics of one black currant bunch (average for 2017−2019)

Soil maintenance between rows (Factor A)	Fertilisation (Factor B)	Soil maintenance between rows (Factor C)	Number of bunches per bush	Bunch length (cm)
Black fallow	Control (without fertilisers)	black fallow	100	3.5
		mulching with straw	185	3.9
		mulch film	148	4.0
	Background ($N_{60}P_{90}K_{90}$)	black fallow	200	5.8
		mulching with straw	234	5.7
		mulch film	297	5.0
	Background + Riverm 1%	black fallow	328	5.2
		mulching with straw	456	5.2
		mulch film	465	6.7
	Background + Riverm 3%	black fallow	423	4.6
		mulching with straw	543	6.2
		mulch film	530	4.9
	Background + Riverm 5%	black fallow	418	5.5
		mulching with straw	604	6.1
		mulch film	538	6.1
Grassing	Control (without fertilisers)	black fallow	85	3.8
		mulching with straw	109	4.0
		mulch film	100	4.1
	Background ($N_{60}P_{90}K_{90}$)	black fallow	100	4.6
		mulching with straw	185	4.3
		mulch film	120	4.6
	Background + Riverm 1%	black fallow	224	4.6
		mulching with straw	376	5.1
		mulch film	316	4.2
	Background + Riverm 3%	black fallow	292	5.0
		mulching with straw	448	5.1
		mulch film	346	6.2
	Background + Riverm 5%	black fallow	361	4.5
		mulching with straw	446	6.2
		mulch film	430	5.8
$LSD_{0.05}$		*A*	*8*	*0.2*
		B	*9*	*0.2*
		C	*11*	*0.3*

Table 2. The number of fruits and fruit weight per bunch of black currant (the average for 2017−2019)

Soil maintenance between rows (Factor A)	Fertilisation (Factor B)	Soil maintenance between rows(Factor C)	The number of fruits per bunch	The number of fruits per bush	Fruit weight per bunch (g)
Black fallow	Control (without fertilisers)	black fallow	6.0	594	6.2
		mulching with straw	3.7	676	4.4
		mulch film	4.7	686	5.4
	Background ($N_{60}P_{90}K_{90}$)	black fallow	4.1	784	4.9
		mulching with straw	4.5	1037	6.1
		mulch film	3.5	1025	4.7
	Background + Riverm 1%	black fallow	2.6	865	3.4
		mulching with straw	2.8	1216	4.1
		mulch film	2.3	1064	3.3
	Background + Riverm 3%	black fallow	2.4	980	3.4
		mulching with straw	2.5	1323	3.8
		mulch film	2.6	1324	3.8
	Background + Riverm 5%	black fallow	2.4	960	3.2
		mulching with straw	2.2	1315	3.3
		mulch film	2.3	1209	3.4
Grassing	Control (without fertilisers)	black fallow	6.4	546	6.2
		mulching with straw	5.8	631	6.1
		mulch film	6.2	617	6.4
	Background ($N_{60}P_{90}K_{90}$)	black fallow	7.1	707	7.7
		mulching with straw	4.5	787	5.2
		mulch film	6.7	796	7.9
	Background + Riverm 1%	black fallow	3.2	718	3.6
		mulching with straw	2.8	1035	3.5
		mulch film	3.6	1132	4.7
	Background + Riverm 3%	black fallow	2.7	775	3.1
		mulching with straw	2.6	1151	3.6
		mulch film	3.6	1234	5.0
	Background + Riverm 5%	black fallow	2.2	778	2.6
		mulching with straw	2.3	1005	3.1
		mulch film	2.7	1133	3.7
$LSD_{0.05}$		*A*	*0.1*	*11*	*0.1*
		B	*0.2*	*16*	*0.1*
		C	*0.1*	*19*	*0.2*

(Table 1).

Soil maintenance in the rows as bare fallow had a positive effect on the growth and development of plants in terms of the availability of nutrients to them, and control treatments differed in the number of bunches per bush by 15 and a bunch length by 0.3 cm However, in the treatments with soil maintenance in rows as bare fallow, the biometric indicators of a bunch of black currant were lower compared to mulching. This was due to the fact that bush rows are more difficult to treat and the plants are either damaged by tillage tools or suffer from weeds, while mulch effectively eliminates both problems.

Therefore, the maximum number of black currant bunches (604) was obtained in the treatment with keeping the soil between rows as bare fallow, the use of fertiliser background ($N_{60}P_{90}K_{90}$) + Riverm 5%, and mulching the soil in rows with straw. The mulch film was less effective due to the irrational distribution of precipitation over the field area, specifically water runoff into the rows. However, even under such conditions, 538 bunches per bush was obtained along with good indicators of bunch length of 6.1 cm.

The results on the fruit number per bunch and per bush, and the fruit weight of black currant are presented in Table 2.

The fruit number per bunch varied greatly within our experiment and we were able to identify not patterns but trends. Thus, in the control treatments without the

Table 3. The productivity of black currant as affected by the components of cultivation technology (the average for 2017−2019)

Soil maintenance between rows (Factor A)	Fertilisation (Factor B)	Soil maintenance between rows (Factor C)	Fruit weight (g)	Fruit yield (t/ha)
Black fallow	Control (without fertilisers)	black fallow	1.46	4.12
		mulching with straw	1.57	5.31
		mulch film	1.53	5.26
	Background ($N_{60}P_{90}K_{90}$)	black fallow	1.52	6.24
		mulching with straw	1.63	9.44
		mulch film	1.62	9.24
	Background + Riverm 1%	black fallow	1.61	7.49
		mulching with straw	1.71	11.95
		mulch film	1.67	10.01
	Background + Riverm 3%	black fallow	1.71	9.27
		mulching with straw	1.74	13.44
		mulch film	1.70	13.06
	Background + Riverm 5%	black fallow	1.66	8.79
		mulching with straw	1.74	13.28
		mulch film	1.71	11.93
Grassing	Control (without fertilisers)	black fallow	1.39	3.49
		mulching with straw	1.44	4.44
		mulch film	1.43	4.28
	Background ($N_{60}P_{90}K_{90}$)	black fallow	1.43	5.12
		mulching with straw	1.49	615
		mulch film	1.50	6.25
	Background + Riverm 1%	black fallow	1.47	5.38
		mulching with straw	1.51	8.73
		mulch film	1.55	9.96
	Background + Riverm 3%	black fallow	1.50	6.04
		mulching with straw	1.63	10.69
		mulch film	1.61	11.41
	Background + Riverm 5%	black fallow	1.52	6.16
		mulching with straw	1.58	8.83
		mulch film	1.60	10.29
$LSD_{0.05}$		*A*	*0,02*	*0.20*
		B	*0.04*	*0,25*
		C	*0.03*	*0.40*

use of fertilisers and with the introduction of fertiliser background ($N_{60}P_{90}K_{90}$) the best values of fruit number per bunch (3.5−7.1) were obtained. At the same time, as in the other treatments of the experiment, the difference ranged between 2.2 and 3.2fruit per bunch. It should also be noted that the fruit weight per bunch in these treatments also proved to be the best with 4.4−7.9 g, while in other treatments fruit weight ranged from 2.6 to 5.0 g

If we analyse the fruit number per bush, the maximum value (1315) was obtained in the treatment with bare fallow between rows, the use of fertiliser background ($N_{60}P_{90}K_{90}$) + Riverm 5%, and the mulching of the soil in rows with straw.

The productivity of black currant is the main indicator of the efficiency of cultivation technology because the fruit weight and the fruit yield are significantly affected by the components of the cultivation technology (Table 3).

The best fruit weight values (1.66−1.74 g) were recorded in the treatment of keeping the soil between rows as bare fallow, background fertilisation$N_{60}P_{90}K_{90}$ + Riverm 3% or Riverm 5% .

It was found that mulching with straw increased the fruit yield by 29%, while mulch film by 28%. The use of mineral fertilisers with foliar dressing using Riverm product increased the fruit yield with the largest its value (13.44 t/ha) in treatment ($N_{60}P_{90}K_{90}$) + Riverm 3% plus

mulching rows with straw. In a similar treatment with the use of a 5% solution of Riverm, a slightly lower yield (13.28 t/ha) was obtained. However, it did not differ statistically significantly from the best value.

Similar patterns were found in the cultivation of black currant with grassing between rows; however, the fruit yield was 13−35% lower than in the similar treatments but with bare fallow.

CONCLUSIONS

It was found that the best growth and development of black currant plants was observed under the soil maintenance between rows as bare fallow and mulching with straw in rows. Bare fallow activates the soil microbiota and facilitates the availability of nutrients to plants. Straw mulch in bush rows is permeable for precipitation, effectively controls weed germination, and prevents damage to blackcurrant plants by tillage tools.

The maximum number of bunches of black currant (604) and the fruit number per bush (1315) were obtained in the treatment with bare fallow between rows, the use of fertiliser background($N_{60}P_{90}K_{90}$) + Riverm 5%. However, the best fruit weight (1.66−1.74 g) was in the treatment with bare fallow between rows, the use of fertiliser background ($N_{60}P_{90}K_{90}$) + Riverm 3% or Riverm 5% .

It was found that the use of mineral fertilisers along with foliar dressing with Riverm increased the fruit yield to 13.44 t/ha in the treatment $N_{60}P_{90}K_{90}$+ Riverm 3% plus mulching bush rows with straw, while applying Riverm 5% resulted in the fruit yield of 13.28 t/ha.

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