



ЗАЩИТА РАСТЕНИЙ НОВОГО СОРТА ЯРОВОЙ ПШЕНИЦЫ МАРСИАНКА

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Представлены результаты изучения воздействия протравителей семян и гербицидов на урожайность и экономическую эффективность нового сорта яровой пшеницы Марсианка. Закладку опыта, наблюдения и учеты проводили по общепринятым методикам. В фазе кущения пшеницы распространенность корневой гнили была на 22% меньше в посевах с применением протравленных семян. В опыте более высокая сохранность урожая от болезни 77,5% и прибавка 0,38 т/га получены в варианте с препаратом Максим Плюс, ВСК с нормой 1,5 л/т. С помощью препаратов Максим Плюс, ВСК и Виал ТрасТ, ВСК (0,4 л/т) натура зерна возросла до 799 г/л, стекловидность – до 65,4%, масса 1000 семян – до 38,6 г, содержание белка – до 16,2%, количество клейковины в зерне – до 36,0%. Виал ТрасТ, ВСК обеспечил лучшие экономические показатели: чистый доход возрос на 23,3%, себестоимость 1 т зерна снизилась на 9,1% и рентабельность повысилась на 20,2%. Обработка посевов в фазу кущения баковой смесью гербицидов Ластик ТОП, МКЭ (доза 0,4 л/га) и Магнум, ВДГ (0,008 кг/га) позволила получить наивысшую в опыте урожайность 3,63 т/га при улучшенном качестве зерна (натурная масса 798 г/л, стекловидность 67,9%, белковость зерна 17,3%). Гербицид Ланцелот 450, ВДГ и баковая смесь Пума Супер 100, КЭ + Секатор Турбо, МД обеспечили массу 1000 зерен 38,1 г и количество клейковины 34,7%. Посевы, обработанные гербицидом Ланцелот 450, ВДГ, баковыми смесями Ластик ТОП, МКЭ + Магнум, ВДГ и Балерина, СЭ + Мортира, ВДГ, обеспечили наибольший чистый доход 15 200–15 300 р./га. Максимальная рентабельность 116,9% и минимальная себестоимость 3688,66 р./т получены от применения препарата Грэнери, ВДГ.

Ключевые слова: пшеница мягкая яровая (*Triticum aestivum* L.), сорт, средство защиты, химический препарат, продуктивность, качество зерна, рентабельность

PLANT PROTECTION OF A NEW VARIETY OF SPRING WHEAT MARSIANKA

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The results of the study of the effect of seed dressers and herbicides on the yield and economic efficiency of the new variety of spring wheat Marsianka are presented. The experimentation, observations and registrations were carried out according to generally accepted methods. In the tillering phase of wheat, the incidence of root rot was 22% lower in crops with dressed seed. In the experiment a higher retention of yield from the disease 77.5% and an increase of 0.38 t/ha were obtained in the variant with

the preparation Maxim Plus, VSK with the rate of 1.5 l/t. Using the preparations Maxim Plus, VSK and Vial TrasT, VSK (0.4 l/t), grain unit increased to 799 g/l, vitreousness - to 65.4%, 1000 seed weight - to 38.6 g, protein content - to 16.2%, gluten content in grain - to 36.0%. Vial TrasT, VSK provided better economic performance: net income increased by 23.3%, the cost per tonne of grain decreased by 9.1% and profitability increased by 20.2%. Crop treatment in tillering phase with a tank mixture of herbicides Lastik TOP, MKE (dose 0.4 l/ha) and Magnum, VDG (0.008 kg/ha) resulted in the highest yield in the experiment 3.63 t/ha with improved quality of grain (natural weight 798 g/l, vitreousness 67.9%, grain protein content 17.3%). The herbicide Lancelot 450, VDG and the tank mixture Puma Super 100, KE + Pruner Turbo, MD ensured a weight of 38.1 g and a gluten content of 34.7%. Crops treated with the herbicide Lancelot 450, VDG, the tank mixtures Lastik TOP, ME + Magnum, VDG and Balerina, SE + Mortira, VDG provided the highest net income of 15,200-15,300 p/ha. A maximum profitability of 116.9% and a minimum cost of 3,688.66 p/t were obtained from the use of Greneri, VDG.

Keywords: spring soft wheat (*Triticum aestivum* L.), cultivar, protective agent, chemical preparation, productivity, grain quality, profitability

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Conflict of interest

The authors declare no conflict of interest.

INTRODUCTION

Wheat is the most important crop cultivated almost all over the Russian Federation and forms the basis of the country's grain complex, which development directly affects its food security [1].

Spring wheat in Eastern Siberia is the main grain crop grown for vegetable protein. This is due to its high technology and productivity, as well as the demand for its consumption by the population [2]. The task of crop cultivation technologies, including spring wheat, is to ensure high crop yields while optimizing labor and material and financial costs per unit of quality products¹. It is possible to realize the potential of new wheat varieties in the formation of high quality grain yields by including in its production system the technologies that ensure the effective use of agricultural intensification means (organic and mineral fertilizers, biological preparations and plant protection agents

against weeds, pests and diseases), which guarantee environmental safety [3]. Modern farming methods have significantly increased yields over the past 50 years, including through chemical control of plant pests and the use of new varieties and hybrids [4].

Among the factors that negatively affect the yield and quality of crops, including wheat, plant diseases stand out [5]. Root rot of various etiologies is a harmful disease of cereal crops worldwide. Fungi of genera *Rhizoctonia*, *Pythium*, and *Fusarium* are most often noted as causative agents of common root rot in the works of foreign scientists studying the control of this disease [6, 7]. In the Irkutsk region, root rot also annually causes serious damage to spring wheat crops. Its main causative agents are *Bipolaris sorokiniana* (Sacc.) Shoemaker. Syn.: *Helminthosporium sativum* Pammel, C.M. King et Bakke, *Helminthosporium sorokinianum* Sacc., *Drechslera sorokiniana* (Sacc.) Subram. Et P.C. Jain.; species of the genus *Fusarium* (*F. culmo-*

¹Innovative technologies in farming and crop production in the Irkutsk region. Scientific and production recommendations. Irkutsk: FSBEI HE "Irkutsk State Agrarian University", 2021. 216 p.

rum (W.G.Sm.) Sacc. var. *culmorum*, *F. avenaceum* (Fr.) Sacc. var. *avenaceum*, *F. oxysporum* Schltdl. var. *oxysporum*, *F. graminearum* Schwabe, etc.). Species of the genus *Alternaria* (*A. alternata* species complex, etc.) are found in the root part of the stem, roots, and rhizosphere of wheat [8].

The formation of clusters in the district for the production of environmentally safe quality grain products demanded in the world market is possible on the basis of integrated chemicalization, including herbicidal and fungicidal plant protection [9]. The role of varietal characteristics in the development of root rot and leaf spot diseases was manifested in the lower incidence of root rot in mid-maturing varieties at tillering and milk-ripening stages of grain (by 31.0 and 23.4%, respectively) compared to mid-late ones [10]. Foreign researchers note the economic benefit of seed dressing with fungicides [11]. In Russia, the economic feasibility of expanding the volume of the rational system of protection of grain crops is confirmed by the effectiveness of the use of pesticides according to the indicator of the saved yield from pests, diseases and weeds (32.1%) of the potentially possible level of prevention of yield losses. At the same time, a relatively high level of profitability is achieved (67.7%) compared to the general indicators of grain production (24.9%) [12]. The use of chemical protection agents allows to stabilize the phytosanitary situation in agroecosystems by 70-95%, reducing yield losses from diseases, and ensure high crop productivity [13, 14].

In the soil and climatic conditions typical for the forest-steppe zone of Western Siberia, the use of fungicide seed dressing agents on fallow forecrop provides a reliable increase in wheat yield by 2.5%, from dressing agents and insecticides - by 14.4%, from the complex of phytosanitary agents - by 24.4% [15]. Manufacturers improve the range of fungicides, releasing to the market environmentally safe preparations, which at the same time have high efficiency against the target objects [16].

The purpose of the study was to study the effect of fungicides and herbicides on produc-

tivity, grain quality and economic efficiency of cultivation of the new variety of spring wheat Marsianka.

MATERIAL AND METHODS

Studies were performed in 2019, 2020 in the experimental field of the Irkutsk Research Institute of Agriculture. The object of the research is a new variety of spring wheat (*Triticum aestivum* L.) Marsianka. The influence factors of seed dressing and herbicide treatment were studied.

The experiment on fungicide application had the following scheme:

- Control (without seed treatment);
- BisolbiSan, L at the rate of 1 l/t;
- Oplot Trio, WSC - 0.5 l/t;
- Grandsil Ultra, SC - 0.5 l/t;
- Maxim Plus, WSC - 1.5 l/t;
- Vial TrasT, WSC - 0.4 l/t.

The experiment scheme for herbicide treatment of crops contained the following options for the use of preparations:

- Control (no herbicides);
- Granery, WDG at a rate of 0.025 kg/ha;
- Lancelot TM 450, WDG - 0.033 kg/ha;
- Lastik TOP, ME - 0.5 l/ha;
- Lastik TOP, ME - 0.4 l/ha + Magnum, WDG - 0.008 kg/ha;
- Ballerina, SE - 0.4 l/ha + Mortira, WDG - 0.015 kg/ha;
- Puma Super 100, EC - 0.6 l/ha + Secator Turbo, MD - 0.05 l/ha;
- Puma Plus, EC - 1.5 l/ha.

Field experiments were laid on clean fallow. Soil of the experimental plot (according to its granulometric composition) contained 4.5-4.9% of humus in the tilled layer (20-22 cm), 0.27% of total nitrogen (according to Kjeldahl), 11.2-11.9 mg of labile phosphorus and 7.9-8.6 mg of exchangeable potassium per 100 g of soil (according to Kirsanov), pH 4.6-4.9.

Wheat varieties were sown on May 10 with seeding rate of 7 million germinated seeds/ha. The area of plots was 75 m², and the repetition was three times. Plots were arranged systematically with an offset in each repetition. Experiment setting, observations and recordings were

made according to the approved methodology². We counted weeds according to the method of the All-Russian Plant Protection Institute³ before herbicide treatment in the phase of tillering of wheat varieties and 25 days after it on fixed trial plots (0.25 m²) with four replications per plot in each replication. Yields in the phase of full grain ripeness were recorded after recalculation to 14% moisture content and 100% purity.

Meteorological conditions during the years of observations differed significantly from the mean annual values. Precipitation was 9.8% lower than normal during hot and dry growing seasons, while the sum of active air temperatures exceeded the mean annual values by 29.7%.

RESULTS AND DISCUSSION

The results of field experiments on the use of fungicides confirmed that the studied preparations markedly restrained the defeat of root rot, favorably affecting the growth and development of wheat plants. In the tillering phase, the disease incidence in the control variant (without seed dressing) was quite high and amounted

to 80.1% with a disease development index of 1.4 points.

After seed treatment, the preparation Maxim Plus, WSC at a dose of 1.5 l / t was the most effective of all, reducing the incidence and index of disease development by 3.6 and 3.5 times, respectively. Chemical disinfectants Grandsil Ultra, SC, 0.5 l/t and Oplot Trio, WSC, 0.5 l/t were slightly inferior to it with the rates of 25.6 and 28.2%, respectively (see Table 1). Biological preparation BisolbiSan, L reduced the degree of disease lesion only by 22.6%.

Disease prevalence at full ripeness of wheat exceeded 98% and was not affected by the studied preparations. A relatively better effect was produced by Maxim Plus, WSC (95.9%).

The results of the field studies revealed that the most effective means of plant protection against weeds was a tank mixture of herbicides Lastik TOP, ME and Magnum, WDG (81.9%). By a statistically insignificant value it was inferior to the herbicide Puma Plus, EC and a mixture of Ballerina, SE + Mortira, WDG. The most ineffective was herbicide

Табл. 1. Показатели корневой гнили в растениях нового сорта яровой пшеницы Марсианка при воздействии биологического препарата и химических протравителей, %

Table 1. Indicators of root rot in plants of a new spring wheat variety Marsianka affected by the biological preparation and chemical dressers, %

Prevalence of root rot by vegetation phase	Dressing agent (biological and chemical preparations)					
	Control (without treatment)	BisolbiSan, L, 1 l/t	Oplot Trio, WSC - 0.5 l/t	Grandsil Ultra, SC - 0.5 l/t	Maxim Plus, WSC - 1.5 l/t;	Vial TrasT, WSC - 0.4 l/t.
<i>Occurrence</i>						
Tillering	80,1	62,0	28,2	25,6	22,5	46,0
Full ripeness	97,0	97,2	98,0	96,4	95,9	98,1
Average by the experiment	88,6	79,6	63,1	61,0	59,2	72,1
<i>Development index</i>						
Tillering	1,4	1,0	0,3	0,4	0,4	0,6
Full ripeness	1,6	1,4	1,6	1,5	1,8	1,7
Average by the experiment	1,5	1,2	1,0	1,0	1,1	1,2

²Methodology of State Variety Testing of Agricultural Crops. Moscow: State Commission on Crop Variety Testing, 1989. 195 p.

³Methods of accounting for pests. Recommendations of VIZR // Plant Protection and Quarantine. 2002. № 2, 3. pp. 49-54.

Lastik TOP, ME, 0.5 l/ha outside the tank mixture (see Table 2).

Preservation of yield from diseases due to the action of biological and chemical preparations allows us to obtain an increase compared to the control in the amount of 0.07 t/ha, or 2.5% - BisolbiSan, L to 0.38 t/ha, or 13.6% - Maxim Plus, WSC. Biological preparations gave the lowest yield increase. Chemical seed dressers provided a reliable increase in the gross grain yield (see Table 3).

The improvement of safety of the yield at seeding with treated seeds was accompanied by the increase of some grain quality indices: natural grain weight - by 3-15 g/l, vitreousness - by 0,4-1,9%, thousand-kernel weight - by 0,1-1,1 g, protein content - by 0,1-1,0% and the quantity of gluten in grain - by 0,3-2,9%. This range of variation of values is due to the different effects of the studied plant protection products, of which Vial TrasT, WSC and Maxim Plus, WSC were the most effective.

Табл. 2. Уровень засоренности посевов нового сорта яровой пшеницы Марсианка при обработке гербицидами и их баковыми смесями

Table 2. The level of weediness in crops of the new spring wheat variety Marsianka when treated with herbicides and their tank mixtures

Herbicide and tank mixture, dose	Number of weeds, pcs. /m ²		Biological efficiency, %
	before treatment	after treatment	
Control (without herbicides)	74	80	—
Granery, WDG, 0.025 kg/ha	72	14	80,5
Lancelot 450, WDG - 0.033 kg/ha	75	14	81,3
Lastik TOP, ME - 0,5 l/ha	74	35	52,7
Lastik TOP, ME - 0,4 l/ha + Magnum, WDG - 0,008 kg/ha	72	13	81,9
Ballerina, SE - 0,4 l/ha + Mortira, WDG - 0,015 kg/ha	76	14	81,6
Puma Super 100, EC - 0.6 l/ha + Secator Turbo, MD - 0.05 l/ha	74	15	79,7
Puma Plus, EC - 1.5 l/ha	71	13	81,7
Average value	73,5	24,8	

Табл. 3. Урожайность и качество зерна нового сорта яровой пшеницы Марсианка при воздействии биологических препаратов и химических протравителей

Table 3. Yield and grain quality of the new spring wheat variety Marsianka affected by biological preparations and chemical disinfectants

Dressing agent (biological and chemical preparations), dosage	Yield, t/ha	Grain unit, g/l	Vitreousness, %	Thousand-kernel weight, g	Content, %	
					protein	crude gluten
Control (without herbicides)	2,79	784	63,5	37,5	15,2	33,1
BisolbiSan, L, 1 l/t	2,86	787	63,9	37,6	15,3	33,4
Oplot Trio, WSC, 0.5 l/t	3,03	794	64,8	38,1	15,9	35,3
Grandsil Ultra, SC, 0.5 l/t	3,07	795	65,0	38,3	16,0	35,6
Maxim Plus, WSC, 1,5 l/t	3,17	798	65,3	38,6	16,2	35,8
Vial TrasT, WSC, 0,4 l/t	3,15	799	65,4	38,6	16,1	36,0
Average value	3,00	792	64,6	38,1	15,8	34,7
LSD	0,27	66,1	5,74	0,74	1,28	2,45

Treatment of wheat crops with herbicides and their tank mixtures helps to preserve the harvest to a greater extent and contributes to achieving higher productivity of the variety and grain quality (see Table 4).

Application of the tank mixture Lastik TOP, ME and Magnum, WDG, as well as the preparation Puma Plus, ME resulted in the highest yield increases of 0.43 and 0.42 t/ha, respectively, or 13.4 and 13.1%. Grain quality indicators show that the values of bulkiness (798 g/l), vitreousness (67,9%) and grain protein content (17,3%) were the best in the variant with the bath mixture Lastik Top, ME + Magnum, WDG. By weight of 1000 grains with the same value of 38.1 g Lancelot 450 herbicide, WDG and a tank mixture of Puma Super 100, ME + Secator Turbo, MD, stood out with the latter also having the best content of crude gluten (34.7%).

Economic benefit from the pre-sowing treatment of wheat seeds of the Marsianka variety by the studied preparations was confirmed not only by the increase of the profitability level from 98,9 to 118,9%, depending on the preparation used, but also by the

increase of the net income from 11 100 to 13 690 rubles/ha and the decrease of the cost of production from 4021,5 to 3654,0 rubles/ton. Significantly higher economic indicators have chemical seed dressers. And the best values of all presented economic indicators provided the preparation Vial TrasT, WSC with the rate of 0.4 l / t (see Table 5). Biological means of protection BisolbiSan, L brought the lowest in the experiment net income 11540 r./ha (4.0% higher than the control), profitability (+ 2.9% to the control) and the cost of 1 ton of grain 3965.0 r.

Despite the increase in production costs of growing grain due to the use of chemical means of weed control, the revenue received from the increase in yield justifies the costs incurred and provides an increase in economic performance.

The highest net income (15.2-15.3 thousand rubles/ha) was obtained when treating crops with herbicide Lancelot 450, WDG, tank mixtures Lastik TOP, ME + Magnum, WDG and Balerina, SE + Mortira, WDG. With regard to the maximum profitability of production (116,9%) and the minimum cost of 1 ton

Табл. 4. Урожайность и качество зерна нового сорта яровой пшеницы Марсианка при обработке посевов гербицидами и их баковыми смесями

Table 4. Yield and grain quality of the new spring wheat variety Marsianka in crops affected with herbicides and their tank mixtures

Name of herbicide or herbicide tank mixture, dose	Yield, t/ha	Grain unit, g/l	Vitreousness, %	Thousand-kernel weight, g	Content, %	
					pro-tein	crude gluten
Control (without herbicides)	3,20	787	65,8	36,9	15,9	32,6
Granery, WDG, 0.025 kg/ha	3,44	792	66,7	37,8	16,5	33,8
Lancelot 450, WDG - 0.033 kg/ha	3,54	794	66,5	38,1	16,7	33,9
Lastik TOP, ME - 0,5 l/ha	3,51	789	66,2	37,7	16,4	32,8
Lastik TOP, ME - 0,4 l/ha + Magnum, WDG - 0,008 kg/ha	3,63	798	67,9	37,8	17,3	34,6
Ballerina, SE - 0,4 l/ha + Mortira, WDG - 0,015 kg/ha	3,58	791	67,2	38,0	16,9	34,4
Puma Super 100, EC - 0.6 l/ha + Secator Turbo, MD - 0.05 l/ha	3,49	793	67,6	38,1	17,1	34,7
Puma Plus, EC - 1.5 l/ha	3,62	796	66,9	37,9	17,0	34,8
Average value	3,00	792	64,6	38,1	15,8	34,7
LSD	0,29	63,7	5,5	1,0	1,3	2,8

Табл. 5. Экономическая эффективность протравливания семян нового сорта яровой пшеницы Марсианка**Table 5.** Economic efficiency of seed treatment for the new spring wheat variety Marsianka

Dressing agent (biological and chemical preparations), dose	Conditional net income, r./ha	Cost price of 1 ton of grain, r.	Breakeven level, %
Control (without treatment)	11 100	4021,5	98,9
BisolbiSan, L, 1 l/t	11 540	3965,0	101,8
Oplot Trio, WSC, 0.5 l/t	12 570	3851,5	107,7
Grandsil Ultra, SC, 0.5 l/t	13 040	3752,4	113,2
Maxim Plus, WSC, 1,5 l/t	13 260	3817,0	109,6
Vial TrasT, WSC, 0,4 l/t	13 690	3654,0	118,9
Average value	12 533	3843,6	108,4

Табл. 6. Экономическая эффективность обработки посевов нового сорта яровой пшеницы Марсианка гербицидами и их баковыми смесями**Table 6.** Economic efficiency of dressing the crops of the new spring wheat variety Marsianka with herbicides and their tank mixtures

Name of herbicide or herbicide tank mixture, dose	Conditional net income, r./ha	Cost price of 1 ton of grain, r.	Breakeven level, %
Control (without herbicides)	13 176	3882,50	106,1
Granery, WDG, 0.025 kg/ha	14 831	3688,66	116,9
Lancelot 450, WDG - 0.033 kg/ha	15 233	3696,89	116,4
Lastik TOP, ME - 0,5 l/ha	13 984	4015,95	99,2
Lastik TOP, ME - 0,4 l/ha + Magnum, WDG - 0,008 kg/ha	15 227	3805,23	110,2
Ballerina, SE - 0,4 l/ha + Mortira, WDG - 0,015 kg/ha	15 343	3714,25	115,4
Puma Super 100, EC - 0.6 l/ha + Secator Turbo, MD - 0.05 l/ha	13 246	4204,58	90,3
Puma Plus, EC - 1.5 l/ha	13 820	4182,32	91,3
Average value	14 358	3898,80	105,7

of grain (3688,66 rubles) the preparation Granery, WDG stood out due to the lowest cost of its purchase (see Table 6).

CONCLUSIONS

1. The intensity of plant growth and development, productivity, grain quality and economic efficiency of cultivation of the new variety of spring wheat Marsianka largely depends on the use of protective agents (seed dressers and herbicides). Chemical disinfectants are twice as effective as biological preparations in terms of effectiveness (degree of reduction of disease incidence and preservation of plants for harvesting).

2. The biological efficacy of the tank mixture Lastik TOP, ME + Magnum, WDG in wheat crops was 81.9%. Its superiority over the tank mixture Balerina, SE + Mortira, WDG and herbicides Puma Plus, ME is statistically insignificant.

3. The highest harvest of quality grain (3.15 and 3.17 t/ha) was obtained with pre-sowing dressing of seeds with Maxim Plus, WSC with the rate of 1.5 l / t and Vial TrasT, WSC - 0.4 l / t. The growth of productivity was accompanied by improvement of the quality of grain: grain size increased to 15 g/l, vitreousness - by 0,4-1,9%, weight of 1000 seeds - by 0,1-1,1 g, protein content - by 0,1-1,0% and gluten content

in grain - by 0,3-2,9%. The treatment of crops in the phase of tillering with a tank mixture of herbicides Lastik Top, ME, 0.4 l / ha and Magnum, WDG at a dose of 0.008 kg / ha led to the highest in the experiment yield 3.63 t / ha with improved quality of grain: natural weight - 798 g / l, vitreousness - 67,9% and protein content in grain - 17.3%. The highest indicators of the weight of 1000 grains (38.1 g) and the amount of gluten (34.7%) in wheat were observed in variants with the herbicide Lancelot 450, WDG and a tank mixture of Puma Super 100, EC + Secator Turbo, MD.

4. The economic advantage of pre-sowing treatment of wheat seeds of the Marsianka variety with investigated chemical means of protection is proved by reliable growth of net income by 23,3%, reduction of production costs by 9,1% and increased profitability by 20,2%. The best values of all noted economic indicators provided the preparation Vial TrasT, WSC with the rate of 0.4 l / t. The excess of the indicator of net income over the control variant from the use of the biological preparation BisolbiSan, L was only 4.0%.

5. Chemical means of weed control provide additional profits from increasing yields and obtaining quality products. The greatest net income (15.2-15.3 thousand roubles/ha) was obtained from the crops treated with Lancelot 450 herbicide, WDG, tank mixtures of Lastik TOP, ME + Magnum, WDG and Balerina, SE + Mortira, WDG. Preparation Granerie, WDG maximized profitability to 116.9% and made the production of 1 ton of grain cheaper to 3688.66 roubles due to the lower cost.

СПИСОК ЛИТЕРАТУРЫ

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