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Managing of Spring Barley Fungal Spot Blotch Disease under the Basic, Intensive and Highly Intensive Cultivation Technologies in Moscow

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ABSTRACT

Spring barley (Hordeum vulgare L.), is one of the fourth largest grain in the world but insects, weeds and diseases agents lead to crop losses and declination of incomes. Fungal diseases cause serious losses in spring barley prompting the need to find an effective strategy of control. In the quest to find a suitable strategy, application of three treatments, highly intensive, intensive and basic. In 2020, varieties (factor A) of spring barley were grown: Elf, Yaromir and Vladimir, which were placed in experimental variants that differed in the level of application of mineral fertilizers and plant protection products-basic, intensive and highly-intensity technologies (factor B). We studied seeding rates 4, 5 and 6 million germinating grains per hectare. The technology used modern drugs from Keminova), involving the application of fungicides and fertilizer compounds were evaluated for the control of fore critical fungal disease such as spot blotch (Bipolaris sorokiniana) disease spring barley varieties Elf, Yaromir and Vladimir. The outcome of the experiment shows that the basic technology treatment with fertilizers and mixture of herbicide, insecticide and fungicides compounds were the most effective strategy in controlling the fungal spot blotch disease, weeds, insects and increasing the yields of three varieties Elf, Yaromir and Vladimir, which was used only in autumn spring defense is forecast. The yield in the intensive treatments was close in value, respectively, 10.47 t/ha, 10.27 t/ha and 9.15 t/ha which is higher by 27%, 21% and 33 % compared to basic treatments. The outcome was reflected in the segments of the grain yield, with the end goal that the weight and mass of 1000 part were improved in three therapies contrasted with fundamental since the high escalated application was more compelling in such manner. The 3 treatments such as, highly intensive, intensive and basic technologies (factor B) on three spring barley varieties (Factor-A), to control fungal disease in three replicated factorial in randomized complete block design (RCBD) containing net plot size i.e., 2 m × 5 m (10 m2). The experiments were fulfilled during the year 2020 and impact of the 3 diverse mixed protection basic, intensive and highly intensive technologies were tested.

Keywords- Spring barley, Varieties, Fertilizers, Fungicides, Fungal disease.

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I. INTRODUCTION

Barley (*Hordeum vulgare* L. ssp. vulgare, 2n=14) is a member of family Poaceae. In terms of overall word production, spring barley has its fourth place after wheat, rice and corn. In 2009, worldwide production was nearly 152 million tones (FAOSTAT, 2011). It occupies 57 million hectares of the world's agricultural land and is consumed in malt, by animals and people (Grando and Macpherson 2005, Newton et al., 2011). However, the average (2007-2015) yields of winter barley are almost 2 times (93 percent) higher than average yield of spring barley. Over the last 9 years, yields of winter barley decreased. The trend line forecast this yield in 2016 at slightly over 3.6 MT/HA. Yields of spring barley are stagnant at approximately 2.0 MT/HA (FAS/Moscow 2016). Demands for cereal products in the world will increase by more than 50% over the next 20 years when the need for development new technologies and in traditional science (Borlaug, 2007). Fungal diseases represent a major constraint on barley production global and regionally, despite significant efforts to control and manage responsible pathogens. The breakdown of host resistance to pathogen, the development of pathogenic inspection to fungi, and the growing importance of pathogens previously thought to be of minor importance, mean that diseases will continue to pose a threat to production to global cereals such as barley. These bio-restrictions, coupled with increased legislation aimed at protecting the environment, have led to increased efforts to find more sustainable approaches to disease control.
Such approaches clearly require the balance of crop protection against biological threats such as diseases, crops and lewdness, with the need to minimize environmental damage, and require an integrated approach to crop protection. Integrated pest management (IPM) means different things to different people and not surprising therefore, there have been many definitions of IPM (Jeger 2000).

Annually, a range of fungal diseases threaten barley crop. These include blotch or leaf scald, powdery mildew, net blotch, brown rust, yellow rust and Ramularia leaf spot. Spot blotch is caused by Helminthosporium sativum or H. sorokinianum=Drechslera sorokiniana (Bipolaris sorokiniana). The disease is widespread in Illinois and is believed to lower potential barley yields by 1 to 3 percent; also, the bushel weight. The causal fungus affects all parts of the plant and produces a variety of symptoms, from a seedling blight and root rot to “Black point” of the kernels.

The barley spots blotch disease symptoms such as spots or injuries that are chocolate earthy colored to-dark show up close to the dirt line or at the foundation of the sheaths that cover the seedling leaves. Diseases may advance until the seedlings become yellow and then become to die on, either previously or after rise, hence decreasing the stand. The last case is more incessant. Influenced seedlings might be overshadowed, turner unreasonably, and have dark green leaves. Ailing grain seedlings generally have debilitated dull earthy colored, spoiled crowns and roots.

II. RESEARCH AND METHODS

Three varieties of spring barley Elf, Yaromir and Vladimir (factor A) were grown in Research Institute of Agriculture Nemchinovka Moscow-Russia region, Odintsovskiy district, Russia. (55° 45′ N, 37°37′ E and 200 m height). Which were placed in experimental variants that differed in the level of application of mineral fertilizers and plant protection products-basic, intensive and high-intensive technologies (factor B). We studied seeding rates 4, 5 and 6 million germinating grains per hectare. The technology used modern drugs from Keminova in 2020).

- ***Basic Technology***: Designed for the planned yield of 5-6 tons per hectare.

Fertilizer doses were N60P60K90 (N30P60K90 - the main application, N30- spring in the deposit). The plant protection system is represented by a tank mixture of herbicide, insecticide, and fungicide (Lintur 180 kg/ha Danadim 1 kg/ha Fundazole 0.5 kg/ha), which was applied only in autumn. Spring defense is forecast.

- ***Intensive Technology*****:** planned yield 6 - 8 t/ha. The fertilizer application doses were N90P60K120 (N30P60K120 - the main application, N30 in spring in tillers and N30 in the phase of coming out into the tube). Since autumn - application of plant protection products (herbicides, insecticides, and fungicides) - Lintur 180 g / ha + Vantex 0.06 l / ha + Impact SK 0.5 kg / ha, in spring - insecticide danadium Power 1 l / ha + fungicide Alto Super 0.5 l / ha + retardants Perfect 0.4 l / ha (GS 21 - 22 phase). In the spring, in the presence of bluegrass weeds, Foxtrot 1.0 l / ha + Agrokson 0.5 l / ha, Perfect 0.3 l / ha (GS 31-32 phase) were applied fungicides Impact Super 0.75 l / ha + Danadium Power 0.6 l /ha. Ear protection according to the forecast.
- ***Highly intensive technology:*** planned yield 9 - 10 tons/ha. Fertilizer intake doses were N180P120K180 (N30P90K180 - main application, N30 spring in the creation, N30 in the phase of entry into the tube, N30 - in the stabbing). Since autumn - the introduction of plant protection products (herbicides, insecticides and fungicides) - Tandem 30 g/ha, Aton 60 g/ha or Extra 35 g/ha q Danadium Power 1 l/ha, Impact Exclusive 0.5 l/ha, spring - Consul 0.8 l/ha Vantex 60 ml/ha Sapress 0.4 l/ha (phase GS 21 - 22) - Consul 1.0 (fungicide) to protect the flag sheet and ear Danadium In the mass development of pests and epiphytotic development of diseases, the impact of Super 0.75 l/ha or Alto Super 0.5 l/ha is an insecticide called Danadium Power 0.6 l/ha (protection of the colossus). For all variants, the 1 liter/t of Vantex seed was

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etched and the growth regulator Perfect 0.4 liter/spraying of crops were made by "Amazon US - 605".

The severity of spot blotch barley disease in three varieties V1 (Elf) and V2 (Yaromir) and V3 (Vladimir) Indicated that untreated plots (without spraying fungicides) recorded with highest rating disease incidence than 3 treatments T1, T2 and T3 highly intensive which were treated with fungicide compounds.

On cultivar, Elf and Yaromir 0.1% severity in highly intensive treatments compared to basic and intensive 0.3 %, 2.5% and 0.3 and 3.2, respectively. On the variety Vladimir severity of blotch at growth stage in highly intensive, intensive, and basic were 0.0%, 0.8% and 15.7% respectively but incidence ratings of disease in controlled plots were 24.3%, higher than other treatments. Efficacy for curbing of blotch in 3 cultivation treatments such as T1, T2 and T3, ranged from 67.8%, 96% and 98.6% on variety Elf, respectively thus 69.5%, 97.3% and 99% on variety Yaromir and respectively thus 35.3%, 96.7% and 100% on variety Vladimir. These experiments indicate that fungicides in highly intensive compounds have the most effective to control the spring barley blotch disease for three varieties, especially on Vladimir.

Table 1: Disease severity and the efficacy of fungicides in controlling spring barley disease in varieties Elf, Yaromir and Vladimir during 2020

Technologies	Elf variety		Yaromir variety		Vladimir variety		Overall	
	Disease severity%	Efficacy%	Disease severity%	Efficacy%	Disease severity%	Efficacy%	Disease severity%	Efficacy%
1	2.5	67.8	3.2	69.5	15.7	35.3	7.1	49.6
2	0.3	96	0.3	97.3	0.8	96.7	0.4	97.1
3	0.1	98.6	0.1	99	0.0	100	0.06	99.5
Control	7.6	00	10.5	00	24.3	00	14.1	00

Abbreviations: 1– Basic, 2 – Intensive, 3– Highly intensive

III. MATERIALS AND DISCUSSION

The Samples were completed under the environment of states non-chernozem zone at Moscow Research Institute of Agriculture "Nemchinovka" Moscow-Russia region, Odintsovskiy district, Russia. (55° 45′ N, 37°37′ E and 200 m height).

Soil Characteristics

Tests were taken arbitrarily from various plots at 0-15 cm to record the starting soil attributes.

Table 2: Soil characteristics, taken from the experimental site

Soil texture	Typically, loamy
Organic matter	1.70%
PH	5.1-7
Phosphorus (P2O5)	45 to 60 kg per hectare
Potassium (K2O)	60 kg per hectare
Nitrogen (N)	30 to 45 kg per hectare

Harvest structure and yield of spring barley

Biological yield of cultural plants is determined by the formation of the number of productive stems per plant, the number of grains in the ear, the mass of grain from the ear, etc. Indicators these indicators depend on abiotic and biotic factors.

Table 3: Structure of the spring barley harvest with different technologies and plant protection systems, 2020 y.

Varieties	technology	Field germination, %	Number of productive stems, /m2	Massa, g.			Biological yield, g/m2	± to basic technology	
				grains with spike	1000 grains	± to basic		g/m2	%
Elf	1	90	968	1,01	53,2		987		
	2	93	1065	1,04	55,2	+2,0	1109	122	12
	3	95	1071	1,14	56,8	+3,6	1221	234	23
Control		83	811	0,82	48,6	-4,6	673	-314	-31
Yaromir	1	84	964	1,02	51,0		988		
	2	90	980	1,05	52,7	+1,7	1035	47	5
	3	93	1092	1,11	54,9	+3,9	1213	225	23

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Control		85	912	0,86	49,8	-1,2	785	-203	-20
Vladimir	1	87	830	0,99	53,1		823		
	2	95	910	1,04	54,6	+1,2	945	122	15
	3	95	1015	1,12	56,8	+3,4	1135	317	39
Control		84	923	0,81	49,7	-1,3	654	-223	-22

Note: 1 - Basic, 2 - Intensive, 3 - Highly-intensive

Table 4: Biological Effectiveness of Fungicides on Spot Blotch of Spring Barley

Varieties	Technologies	Spot Blotch Disease
Elf	1	67
	2	96
	3	97
Control		7,6
Yaromir	1	70
	2	93
	3	99
Control		10,5
Vladimir	1	35
	2	97
	3	99
Control		24,3

Note: 1 - Basic, 2 - Intensive, 3 – Highly intensive.

Table 5: Yield of spring barley by different cultivation technologies, t/ha (2020)

Varieties	Technologies	Yield t/ha	Increase in yield	
			t/ha	%
Elf	1	9,55	0,85	11
	2	10,74	2,00	27
	3	12,05	3,46	47
	Control	7,32	-	-
Yaromir	1	9,74	0,93	12
	2	10,27	1,64	21
	3	11,98	2,43	31
	Control	7,66	-	-
Vladimir	1	8,16	0,61	9
	2	9,15	2,15	33
	3	11,02	3,17	48
	Control	6,48	-	-

Observations: 1 basic, 2 intensives, 3 highly intensive

Land preparation and planting

Barley planting was done at the optimum time (1 December until late April). Sowing seed rate 180 kg/ha in a systematic way repetition blocks consisted of plot of 10 m2, the repetition was triple. Planting seed rate 180 kg/ha in an orderly way reiteration blocks comprised of plot of 10 m2, the redundancy was triple. A tractor plow was used to till the soil to a depth of 3 to 4 cm. After that, a tractor rake was used to achieve a good slope and leveling of the soil. Weeds and insects were controlled by herbicides and insecticides. Standard cultivation practice was applied. There three cultivars of spring barley, Elf, Yaromir and Vladimir were grown during the seasons 2020 utilizing three various mixed plant protection technologies, high intensive, intensive and basic (Table.2).

➢ *Yield of spring barley Elf variety by different cultivation technologies*

The research results showed that observance of cultivation technologies with an increase in fertilizers and fungicides excessed the yield of spring barley (Table 2). Significant differences in yield during cultivation by different technologies are noted. The results indicated that spring barley grain yields are significantly affected by fertilizer and fungicide application rates in the three cultivation technologies (T1, T2, and T3).

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The intensive and highly intensive treatments increased grain yield by 27% and 47% respectively compared with basic in Elf. The average yields of basic (T1), intensive (T2) and highly intensive (T3) were 0.85, 2.00 and 3.46 T/ha respectively. The highest grain yield recorded in (T3) highly intensive technology.

The mass of 1000 grains increased in Elf. In this experiment observed that the comprehensive application of plant protection products (seed dresser Vinci forte), Since autumn - application of plant protection products (herbicides, insecticides and fungicides) - Lintur 180 g / ha + Vantex 0.06 l / ha + Impact SK 0.5 kg / ha, in spring - insecticide Danadim Power l / ha + fungicide Alto Super 0.5 l / ha + retardants Perfect 0.4 l / ha (GS 21 - 22 phase). In the spring, in the presence of bluegrass weeds, Foxtrot 1.0 l / ha + Agroxon 0.5 l / ha, Perfect 0.3 l / ha (GS 31-32 phase) were applied fungicides Impact Super 0.75 l / ha + Danadim Power 0.6 l /ha. Ear protection according to the forecast can't load full results. Try again Mass of 1000 grain and weight of 1000 grain in three varieties. (Politiko et al in 2016).

Including fertilizers, fungicides and herbicides at different concentrations provides optimal protection against diseases and improves grain yield and quality.

➢ *Yield of spring barley Yaromir variety by different cultivation technologies*

Yields in all three treatments of spring barley (Yaromir) were significantly increased (Table 2). The maximum yield was gained in highly intensive treatment N180P120K180 (N30P90K180 - main application, N30 spring in the creation, N30 in the phase of entry into the tube, N30 - in the stabbing). Since autumn - the introduction of plant protection products (herbicides, insecticides and fungicides) - Tandem 30 g/ha, Aton 60 g/ha or Extra 35 g/ha q Danadim Power 1 l/ha, Impact Exclusive 0.5 l/ha, spring - Consul 0.8 l/ha q Vantex 60 ml/ha q Sapress 0.4 l/ha (phase GS 21 - 22) - Consul 1.0 (fungicide) to protect the flag sheet and ear Danadium In the mass development of pests and epiphytotic development of diseases, the impact of Super 0.75 l/ha or Alto Super 0.5 l/ha is an insecticide called Dunadim Power 0.6 l/ha (protection of the colosus). For all variants, the 1 liter/t of Vantex seed was etched and the growth regulator Perfect 0.4 liter/spraying of crops were made by "Amazon US - 605". To protect the spikes averaged 0.93, 1.64 and 2.43/ha and basic (T1) 0.93 t/ha which exhibited 31% higher yields than T1 when T2 treatments. The optimistic effect of more intensive use of fertilizers and fungicides on winter wheat and spring barley productivity was also found by Politiko et al. (2016). The results show that mineral fertilizers in all treatments had a significant effect on the mass of a thousand grains (TGW). The average weight of 1000 grain, depending on the norm of nitrogen fertilizers in all treatments was 45.2 g – 50.6 g. It was noted that an increase in the rate of nitrogen fertilizers also caused an increase in the average TGW. Politiko et al (2016).

➢ *Yield of spring barley Vladimir variety by different cultivation technologies*

The intensive and high intensive treatments increased grain yield by 33% and 48% respectively compared with basic in Vladimir. The average yields of basic (T1), intensive (T2) and highly intensive (T3) were 0.61, 2.15 and 3.17 T/ha respectively. The highest grain yield recorded in (T3) highly intensive technology.

The research results showed that observance of cultivation technologies with an increase in fertilizers and fungicides excessed the yield of spring barley (Table 2). Significant differences in yield during cultivation by different technologies are noted. The results indicated that spring barley grain yields are significantly affected by fertilizer and fungicide application rates in the three cultivation technologies (T1, T2, and T3).

The mass of 1000 grains increased in Vladimir. In this experiment observed that the comprehensive application of plant protection products (seed dresser Vincit forte), N90P60K120 (N30P60K120 - the main application, N30 in spring in tillering and N30 in the phase of coming out into the tube).Since autumn - application of plant protection products (herbicides, insecticides and fungicides) - Lintur 180 g / ha + Vantex 0.06 l / ha + Impact SK 0.5 kg / ha, in spring - insecticide Danadim Power 1 l / ha + fungicide Alto Super 0.5 l / ha + retardants Perfect 0.4 l / ha (GS 21 - 22 phase). In the spring, in the presence of bluegrass weeds, Foxtrot 1.0 l / ha + Agroxon 0.5 l / ha, Perfect 0.3 l / ha (GS 31-32 phase) were applied fungicides Impact Super 0.75 l / ha + Danadium Power 0.6 l / ha. Ear protection according to the forecast weight of 1000 grain in three varieties. (Politiko et al in 2016).

Table 6: Yield of spring barley by different cultivation technologies, t/ha (2020)

Varieties	Technologies	Yield t/ha	Increase in yield	
			T/ha	%
Elf	1	9,55	0,85	11
	2	10,74	2,00	27
	3	12,05	3,46	47
	Control	7,32	-	-
Yaromir	1	9,74	0,93	12
	2	10,27	1,64	21

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	3	11,98	2,43	31
	Control	7,66	-	-
Vladimir	1	8,16	0,61	9
	2	9,15	2,15	33
	3	11,02	3,17	48
	Control	6,48	-	-

Observations: 1 basic, 2 intensives, 3 highly intensive

IV. CONCLUSION

The severity of spot blotch spring barley disease in three varieties V1 (Elf) and V2 (Yaromir) and V3 (Vladimir) Indicated that untreated plots (without spraying fungicides) recorded with highest rating disease incidence than 3 treatments T1, T2 and T3 highly intensive which were treated with fungicide compounds as shown in (Table 1). On cultivar, Elf and Yaromir 0.1% severity in highly intensive treatments compared to basic and intensive 0.3 %, 2.5% and 0.3 and 3.2, respectively. On the variety Vladimir severity of blotch at growth stage in highly intensive, intensive, and basic were 0.0%, 0.8% and 15.7% respectively but incidence ratings of disease in controlled plots were 24.3%, higher than other treatments. Efficacy for curbing of blotch in 3 cultivation treatments such as T1, T2 and T3, ranged from 67.8%, 96% and 98.6% on variety Elf, respectively thus 69.5%, 97.3% and 99% on variety Yaromir and respectively thus 35.3%, 96.7% and 100% on variety Vladimir. These experiments indicate that fungicides in highly intensive compounds have the most effective to control the spring barley blotch disease for three varieties, especially on Vladimir. The experiment demonstrated a better control capacity using the tested rates of fertilizers, fungicides, insecticides and herbicides, therefore recommended to be adopted for effective fungal spot blotch management in spring barley crop. The use of new integrated chemical compound technologies for the managing of spring barley fungal disease at different doses of fertilizers and fungicides shows a promising result. Spring barley fungal spot blotch disease control success was very evident with the application of high intensive compounds N90P60K120 (N30P60K120, since autumn- the introduction of plant protection products (herbicides, insecticides and fungicides)Tandem 30 g/ha, Aton 60 g/ha or Extra 35 g/ha q Danadim Power 1l/ha, Impact Exclusive 0.5 l/ha, spring - Consul 0.8 l/ha Vantex 60 ml/ha Sapress 0.4 l/ha (phase GS 21 - 22) - Consul 1.0 (fungicide) to protect the flag sheet and ear Danadim In the mass development of pests and epiphytotic development of diseases, the impact of Super 0.75 l/ha or Alto Super 0.5 l/ha is an insecticide called Danadim Power 0.6 l/ha (protection of the colosus).

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