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The Effect of Plant Protection Products and Albite on the Yield of Peas.

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ABSTRACT

The aim of the research was the scientific justification for obtaining high yields of peas by application of plant protection products and Albite. The correlation is revealed between the hydrothermal conditions and grain yield, its preservation, photosynthetic activity, plant height, bean length, number of pods, number of seeds per pod, seed weight per plant, and grain yield. In a course of the research it was revealed that plant protection products and Albite allow obtaining in favorable years of 5.06– 5.24 t/ha (tons per hectare) of grain.
Keywords: peas, plant protection products, Albite, preservation of plants, leaf-area duration, yield.

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INTRODUCTION

One of the main tasks of agro-industrial complex is the creation of a stable fodder base and provision of the population with foodstuff. The particular importance in the solution to this problem consists in increased production of peas. Peas are the main grain legume with high protein content and balanced amino acid composition that allows improving the crop rotation and reducing energy consumption.

Currently, one of the ways to increase the yield of peas is a wide use in the production of new high-yielding, drought-resistant varieties of leafless peas, adapted to the specific conditions of the region, as well as improvement of its cultivation technology. One of the techniques, providing a high yield and ecological compatibility, is the use of plant protection products and Albite. Beneficial effect of plant growth regulators, including Albite, was identified in many crops (Eryashev A.P., 2015; Bektyashkin I.P., 2016).

Albite itself is a fungicide. The protective effect of this product against the plant diseases is achieved through the immunization of plants. Combination of the Albite with chemical fungicides, possessing direct eradicatory action, results in the phenomenon of synergy (mutual strengthening of effect). For example, chemical fungicides often protect plants against diseases during the term of their protective action (usually a month), though after the expiration of this period make plants more susceptible to new infection due to reduced immune status of the plants. The supplement of Albite to fungicides allows restoring and strengthening the immunity of plants and extends thereby the protection period (Melkumov E.A., 2006).

Therefore, the development and improvement of pea cultivation methods under the conditions of South forest-steppe of Nonblack Soil Zone are quite relevant and up-to-date since they help to solve the problem on increasing production of vegetable protein in the region.

METHODOLOGY

To perform the tasks assigned in 2012–2014, field experiments were laid out according to the following scheme:

Factor A. Plant protection products.

1. Without plant protection products (control).
2. Plant protection products (spraying with Break insecticide, 0.05 l/ha, at seedling stage and with Sharpei insecticide, 0.3 l/ha, at budding stage; treatment with Pulsar herbicide, 0.75–1.0 l/ha, at the stage of 1-3 leaves; the application of Rex-duo fungicide, 0.4–0.6 l/ha, at the seedling and budding stage).

Factor B. Application of Albite plant growth regulator.

1. Without sprinkling (control);
2. Spraying at the seedling stage, 50 ml/ha;
3. Spraying at the seedling and budding stages (twofold);
4. Spraying at the seedling, budding, and pods formation stages (threefold);
5. Spraying at the budding stage;
6. Spraying at the stage of pods formation.

The allocation of experimental plots was systematic in three replications. The first order plot's area was 60 m^2 (5x12 m), the second order plot's area – 10 m^2 (2x5 m).

Agronomy during the experiment corresponded to that recommended for the region, except of studied options.

The observations, surveys and analyses during the experiments were conducted according to standard techniques. The obtained data were processed by analysis-of-variance method proposed by B.A. Dospekhov (1985) employing statistical software.

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Meteorological conditions in the study years were different. During the vegetation period of the 2012, total precipitation was 127.8 mm, the effective heat sum (active temperatures above 10°C) amounted to 1243.4 °C, the hydrothermal index was 1.03. In 2013, these figures were 130.9 mm, 1528°C, and 0.86; while in 2014 - 21 mm, 783°C, and 0.27, respectively. Thus, 2012 and 2013 were characterized by sufficient hydration, whereas 2014 was very dry year.

OUTCOMES AND DISCUSSION

Our research has shown that the seedlings density varied by years, reaching the highest value (110–130 pcs/m^2) in 2013; seedlings completeness changed in proportion with its density. The viability of pea plants varied according to experimental options and years of research. On the average for 2012–2014, the use of plant protection products did not increase the viability of plants ($F_p<F_t$). Application of the Albite contributed to increase of plants viability. The analysis of particular distinctions of the studied attributes has shown that this index had the advantage against the background of pesticides in case of twofold use of a growth promoting factor, as well as in the budding stage. The interrelation of factors was not established. The moderate correlation was found between the plants viability and yield (r=0.30) (Table 1).

Table 1 The viability of plants, % (the average for 2012–2014)

Plant protection background (A)	Albite application option (B)						The average for factor (A)	
	1st	2nd	3rd	4th	5th	6th		HCP_{05}
Without pesticides (control)	80.8	87.0	84.4	83.3	85.4	80.0	83.5	2.9
The use of pesticides	77.4	81.5	89.6	85.2	89.2	84.4	84.6	
The average for factor (B) HCP_{05} – 5.0	79.1	84.3	87.0	84.2	87.3	82.2	84.0	
HCP_{05} for particular distinctions – 7.1								

Growth promoters are a powerful factor of increasing photosynthetic and production activity of plants. Research conducted by A.V. Malysheva (2009) have shown that with their application the leaf-area duration of peas was increased by 14.2% (from 21.1 to 24.1 thousand m^2/ha); A.N. Kshnikatkina (2011) and P.G. Alenina (2012) noted increase by 14.9% (from 31.5 to 36.2 thousand m^2/ha).

In our studies, on the average over 2012-2014, the use of plant protection products contributed to the increase in leaf-area duration by 20.3%. Its maximum value was noted when spraying peas with Albite at the seedling stage (25.6 thousand m^2/ha), as well as at the seedling+budding stages (24.6 thousand m^2/ha, the average on factor B). When considering the particular distinctions, leaf-area duration was the greatest in the same options as compared to the control against the pesticide background. There was an interaction of factors (Table 2).

Table 2 Leaf-area duration, thousand m^2/ha (the average for 2012–2014)

Plant protection background	Albite application option (B)						The average for factor (A)	
	1st	2nd	3rd	4th	5th	6th		HCP_{05}
Without pesticides (control)	19.1	22.5	20.1	17.6	21.6	20.4	20.2	1.2
The use of pesticides	23.2	28.7	29.1	26.2	19.6	19.2	24.3	
The average for factor (B) HCP_{05} – 2.1	21.1	25.6	24.6	21.9	20.6	19.8	22.3	
HCP_{05} for particular distinctions – 2.9								

There was a strong correlation between the leaf-area duration and grain yield (r=0.72) as well as photosynthetic potential (r=0.98) that can be expressed by the linear regression equations: 1. Y = 0.42 + 0.1 x (significant within the range x = 17–30), 2. Y = – 104.5 + 34.7 x (significant within the range x = 17–30).

Savitsky M.S. (1973) indicates that the harvest structure is qualitative and quantitative reflection of the plants elements and organs, determining the value of the crop and the interaction of organism and environment at individual stages of plants growth and development. It indicates what constitutes the value of the crop.

The research outcomes have shown that on the average in 2012–2014 the plant height in experimental options was not significantly altered with regard to the studied factors (Table 3).

Plant height had weak negative correlation with regard to grain yields (r=0.06), the bean length (r = – 0.09), the number of pods per plant (r = – 0.03); and weak positive correlation with regard to number of seeds per pod (r = 0.07) and seed weight per plant (r = 0.11).

Malysheva A.V. (2009) noted that the application of Albite with the peas contribute to some increase in the beans length (by 4 mm or 6.7%).

The administration of plant protection products in 2012– 2014 contributed to the decrease in the beans length by 4.4% (Table 3). This indicator was maximum in the option without the Albite. Against the pesticide free background this indicator dominated with regard to particular distinctions. There was an interaction of factors.

Table 3 The effect of plant protection products and Albite on the yield structure elements (the average for 2012–2014)

Plant protection background (A)	Albite application option						The average for factor A	
	1st	2nd	3rd	4th	5th	6th		HCP_{05}
The plant height, cm								
Without pesticides (control)	52.3	51.8	54.2	53.6	55.1	54.0	53.5	1.5
The use of pesticides	54.4	53.7	53.3	53.4	54.7	54.9	54.1	
The average for factor (B) HCP_{05}– 2.7	53.3	52.8	53.7	53.5	54.9	54.4	53.8	
HCP_{05} for particular distinctions – 3.8								
The bean length, cm								
Without pesticides (control)	6.3	5.6	5.4	5.9	5.9	5.6	5.8	0.1
The use of pesticides	5.8	5.4	5.7	5.4	5.6	5.9	5.6	
The average for factor (B) HCP_{05}– 0.2	6.1	5.5	5.6	5.6	5.8	5.7	5.7	
HCP_{05} for particular distinctions – 0.3								
The number of plants before harvesting per 1 m^2								
Without pesticides (control)	87	98	92	95	88	83	91	2
The use of pesticides	87	97	96	99	93	87	93	
The average for factor (B) HCP_{05}– 4	87	97	94	97	91	85	93	
HCP_{05} for particular distinctions – 5								
The number of pods per plant								
Without pesticides (control)	3.3	3.2	3.4	3.1	3.1	2.9	3.2	0.2
The use of pesticides	3.7	4.2	3.4	3.7	3.4	3.2	3.6	
The average for factor (B) HCP_{05}–0.3	3.5	3.7	3.4	3.4	3.3	3.0	3.4	
HCP_{05} for particular distinctions – 0.4								
The number of seeds per pod								
Without pesticides (control)	4.6	4.2	4.3	4.3	4.5	4.1	4.4	0.2
The use of pesticides	4.2	4.3	4.4	4.5	4.2	4.7	4.4	
The average for factor (B) HCP_{05}– 0.4	4.4	4.3	4.4	4.4	4.3	4.4	4.4	
HCP_{05} for particular distinctions – 0.5								
Seed weight per plant, g								
Without pesticides (control)	2.97	3.30	3.20	2.57	2.90	2.53	2.91	0.33

The use of pesticides	3.57	3.97	3.40	3.60	3.77	3.57	3.64	
The average for factor (B) HCP_{05}– 0.57	3.27	3.63	3.30	3.08	3.33	3.05	3.28	
HCP_{05} for particular distinctions – 0.81								

Many researchers have noted that the use of growth promoting factors increase the number of plants of the leguminous crops before harvesting (Timoshkin O.A., 2011; Bukhanova L.A., 2014).

The use of plant protection products on average over three years contributed to the increase of the number of plants before harvesting by 2.1%. When considering the particular distinctions, it was established that this parameter was maximal in the experimental options with the same background but without using pesticides, as well as at the treatment of crops with growth promoting factor at the budding stage against the background of pesticides. No interaction of factors was observed.

The use of pesticides increased the number of pods per plant (by 12.5 %). It was maximal (3.7 pods) when spraying peas with Albite at the seedling stage. In the same option against the pesticides background, this indicator dominated when considering particular distinctions (4.2 pods). There was an interaction of factors. The maximum number of pods per plant (the average experimental number is 3.7) was noted in 2012, 3.6 pods - in 2014, and 3.0 pods - in 2013. This index had a strong correlation (r = 0.74) with the grain yield and seed weight per plant (r = 0.80).

According to experimental options, the number of seeds per pod during the research years was not significantly changed on the average for three years (Table 3). The maximum value of this indicator (the average experimental number is 5.2 seeds) was noted in 2012, while the minimum value of 3.6 seeds was observed in 2013, and intermediate value of 4.3 – in 2014. A weak correlation (r = 0.24) was noted between the number of seeds per pod and grain yield as well as seed weight per plant (r = 0.10).

On the average, seed weight per plant for 2012-2014 during the treatment of the crops with plant protection products was greater by 24.1% than that without processing (3.64 g, Table 3). The application of Albite did not increase it significantly. During the analysis of particular distinctions, the effectiveness of the use of growth stimulating factor was revealed at the seedling stage (3.97 g) and the stage of budding (3.77 g) against the pesticides background, as compared with the control (2.97). No interaction of factors was observed.

The greatest seed weight per plant (the average experimental value is 4.55 g) was noted in 2012, whereas it was much smaller in 2013 (2.36 g) and in 2014 (2.85g).

A strong correlation (r = 0.90) was noted between the seed weight per plant and grain yield. This correlation can be expressed as linear regression equation Y=–0.73+1.02x, which is significant within the range x=2.5–4.0.

The main result of any experiment is the effect of the studied factors on productivity. Brezhnev V.V. (2010) and Ozerov O.V. (2013) noted that the use of plant protection products and growth stimulating factors are able to increase the productivity of plants by 15.1 %.

In 2012, the use of plant protection products has increased grain yield by 61.1 % (Table 4). It was maximum when applying Albite at the seedling stage (4.25 t/ha) and at the seedlings+budding stage (4.03 t/ha). This figure dominated, when considering the particular distinctions in the same options against the pesticide background. There was an interaction of factors. The treatment of pea crops with insecticides, fungicides and herbicides in 2013 contributed to increasing the yield by 11.4 % (2.53 t/ha). This was achieved when spraying plants with Albite at the seedling (2.82 t/ha) and budding (2,69 t/ha) stages. With regard to particular distinctions, this indicator was predominant as compared to the control against pesticide free background with application of growth promoting factor at the stage of seedling, against the pesticide background – at the stages of seedling, budding and pods formation. No interaction of factors was observed.

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Table 4 The effect of plant protection products and Albite on the yield of pea grain, t/ha

Plant protection background (A)	Albite application option						The average for factor (A)	
	1st	2nd	3rd	4th	5th	6th		HCP_{05}
2012								
Without pesticides (control)	3.09	3.85	2.82	2.54	2.18	1.40	2.64	0.16
The use of pesticides	3.91	4.65	5.24	5.06	3.22	3.52	4.27	
The average for factor (B) HCP_{05}– 0.28	3.50	4.25	4.03	3.80	2.70	2.46	3.46	
HCP_{05} for particular distinctions – 0.40								
2013								
Without pesticides (control)	1.96	2.60	2.30	2.14	2.53	2.06	2.67	0.26
The use of pesticides	2.51	3.04	2.04	1.95	2.85	2.81	2.53	
The average for factor (B) HCP_{05}– 0.44	2.24	2.82	2.17	2.05	2.69	2.43	2.60	
HCP_{05} for particular distinctions – 0.63								
2014								
Without pesticides (control)	1.87	1.37	1.11	1.43	1.70	1.84	1.87	0.12
The use of pesticides	1.86	2.23	2.21	2.00	2.57	2.44	2.22	
The average for factor (B) HCP_{05}– 0.22	1.87	1.80	1.66	1.72	2.13	2.14	1.89	
HCP_{05} for particular distinctions – 0.30								
On average for 2012-2014								
Without pesticides (control)	2.31	2.61	2.08	2.04	2.14	1.77	2.16	0.13
The use of pesticides	2.76	3.31	3.16	3.20	2.88	2.92	3.04	
The average for factor (B) HCP_{05}– 0.23	2.54	2.96	2.62	2.62	2.51	2.34	2.60	
HCP_{05} for particular distinctions – 0.32								

In 2014, when applying plant protection products, the grain yield of peas rose by 20.6% (2.22 t/ha, Table 4). Yield advantage was observed when spraying plants with Albite at budding stage (2.13 t/ha) and the beginning of the pods formation (2.14 t/ha); the increase was 13.9 and 14.4%. This figure dominated also in the same options (2.57 and 2.44 t/ha) as well as in the option with the application of the growth promoting factor at the seedling stage (2.23 t/ha), and the seedling+budding stages (2.21 t/ha) against the pesticide background. There was an interaction of factors.

On epy average for 2012–2014, when applying plant protection products, the grain yield of peas increased by 40.7% (Table 4). Spraying of crops with Albite at the seedling stage contributed to increase of yield by 23.3%. When considering the particular distinctions, it was revealed that against the pesticides background and growth promoting factors used at the seedling stage, the crop capacity was higher as compared with the absolute control by 43.3%; at the seedling+budding stages – by 36.8%; at threefold treatment – by 38.5%; whereas compared with control against the pesticides background it was 19.9, 14.5 and 15.9%, respectively. There was an interaction of factors.

The grain yield of peas was minimal (on the average in experiment it was 1.89 t/ha) in a very dry year of 2014; 2.60 t/ha – in 2013; and 3.46 t/ha – in 2012. The difference by year ranged from 26.9 to 82.5%.

CONCLUSION

In the cultivation of peas on dark grey forest soils towards increasing the yield of grain, we can recommend farmers to apply plant protection products (spraying with Break insecticides (0.05 l/ha) at the stage of seedling, spraying with Sharpei (0.3 l/ha) at the stage of budding, treatment with the Pulsar herbicide (0.75–1.0 l/ha) at the stage of 1-3 leaves, use of Rex-duo fungicide (0.4–0.6 l/ha) at the stages of seedling and budding), and spraying with Albite (50 ml/ha) at the seedling stage.

REFERENCES

[1] Alenin, P.G., 2012, "Productive Capacity of Cereals, Legumes, Forage, Officinal Croppers and the Improvement of their Cultivation Technology in the Forest-steppe of the Middle Volga Region," Ph.D. thesis, Penza State Agricultural Academy, Penza, 45 p.

[2] Bektyashkin, I.P., 2016, "Influence of Albite on the Growth, Development and Yield of Multi-row Barley," Resource-Saving Ecologically Safe Technologies for Manufacturing and Processing of Agricultural Products. Proceedings of the XI International Science-to-Practice Conference, Saransk, Publishing House of Mordovian University, pp. 111-113.

[3] Brezhnev, V.V., 2010, "Application of Growth Regulators and Herbicides on Spring Wheat Crops in the Steppe Zone of Middle Volga Region," Ph.D. thesis, Samara State Agricultural Academy, Kinel, 22 p.

[4] Bukhanova, L.A., and Zarenkov, N.V., 2014, "Using of Growth Regulators and Micronutrients on Soybean Crops," Forage Production, 6, pp. 21-24.

[5] Dospekhov, B.A., 1985, "Methodology of Field Experiment (including Fundamentals of Statistical Processing of Research Findings)," 5th ed., rev., Moscow, Agropromizdat, 351 p.

[6] Eryashev, A.P., Bektyashkin, I.P., and Kamalikhin, V.E., 2015, "Influence of Mineral Fertilizers and Potassium Humate on the Yield of Polystichous Barley," Biosciences Biotechnology Research Asia, 12 (2), pp. 1551 – 1560.

[7] Kshnikatkina, A.N., Alenin, P.G., 2011, "Efficiency of Plant Growth Regulators, Complex Fertilizers and Bacterial Preparations in the Cultivation of Field Peas (Pisum Arvense L.)," Niva Povolzhya, 2(19), pp. 22 – 27.

[8] Malysheva, A.V., 2009, "Yield and Quality of Peas when Using Plant Growth Regulators, Micronutrients and Rizotorfin on the Southern Chernozems of the Orenburg Cis-Ural Region," Ph.D. thesis, Orenburg State Agrarian University, Orenburg, 22 p.

[9] Mel'kumova, E.A., 2006, "A Biological Preparation to Enhance Crop and Protect Agricultural Crops," Institute of Plant Protection of the RF Ministry of Agriculture, Podolsk, PFOP, 327 p.

[10] Oderov, O.V., 2013, "Formation of Yields and Sowing Qualities of Spring Soft Wheat Seeds Using Plant Protection Products against Weeds in the Conditions of Forest-steppe of the Middle Volga Region," Ph.D. Thesis, Penza State Agricultural Academy, 19 p.

[11] Savitsky, M.S., 1973, "Structure of High Yields of Winter Wheat in the Conditions of the FSU," Edited Volume on Theoretical Aspects of the High Yields Formation, Gorki, 103, pp. 3 – 39.

[12] Timoshkin, O.A., 2011, "Adaptive Cultivation Technology of Broad Beans in the Forest-steppe of Middle Volga Region," Penza, Penza State Agricultural Academy, 225 p.