Efficiency of using complex fertilizers for pre-sowing treatment of seeds and growing plants of buckwheat

Z I Glazova

1Federal State Budgetary Scientific Institution “Federal Scientific Center of Legumes and Groat Crops”, p/b Streletskoye, Orel, 302502, Russia
E-mail: budarinagalina61@mail.ru

Abstract. The paper presents the results of three years of research on the use of various organic and mineral fertilizers for foliar feeding of Druzhina variety buckwheat in the Oryol region. It is noted that the use of complex organic and mineral fertilizers of LLC Polydon Agro: Alfastim, Polydon Boron, Polydon Potassium Plus, Polydon Bio, Polydon NP for pre-treatment of seeds and leaf fertilizing provides an increase in grain yield by 0.19-0.40 t/ha. The share of this factor influence was 12.8-16.9%, depending on weather conditions during the growing season. The positive effect of seed treatment with the biological stimulant Alfastim on buckwheat yield is shown: grain harvest from 1 ha of crops increased by 0.04-0.31 t/ha. It is established that foliar fertilization with organic fertilizers of LLC Polydon Agro is economically justified: with a small consumption (1.6-5.6 t/ha), additional grain collection provides income from 4.90 to 6.02 thousand rubles/ha.

1. Introduction
Obtaining a high yield of buckwheat depends on a number of agrotechnical methods, among which mineral fertilizers account for from 17 to 31% [1]. However, with their high cost, they account for up to 55% of all production costs. Therefore, there is a need to improve the methods of their more rational use, taking into account the needs of plants during the growing season.

It is known that buckwheat in different periods of development consumes nutrients in different amounts: nitrogen and potassium 61-62%, phosphorus – about 40% of the total consumption in the first six weeks after sowing. Buckwheat consumes most of the phosphorus during the flowering period – fruit filling [2]. Often, due to weather conditions, fertilizers implemented into the soil cannot provide plants with nutrients in one or another period of their life [5]. To do this, they use corrective leaf feeding with new-generation agrochemicals with maximum biological activity and minimal negative load on plants. Such drugs include multi-component organic and mineral fertilizers, produced by LLC “Polydon Agro”.

The aim of the research is to evaluate the effectiveness of using complex organic and mineral fertilizers produced by Polydon Agro when processing seeds and vegetative plants for buckwheat productivity.
2. Research methods

Field experiments were carried out in the crop rotation of the laboratory of agricultural technologies and plant protection of the FSC of CGC on dark gray forest medium loamy soil with a content of humus – 4.1 – 4.5%, mobile phosphorus (according to Kirsanov), 15.7–18.1 mg, potassium – 11.2 – 13.8 mg per 100 g of soil, pH$_{akt}$ – 4.9–5.5. Method of seeding – ordinary (15 cm), SKS–6–10 seeder, seeding rate – 3.0 million germinating seeds per 1 ha. The Druzhina buckwheat variety. During the growing season, a set of agrotechnical measures was carried out to take care of crops.

Field experiment included the following options: 1 – control (without fertilizers); 2 – Alfastim (80 ml/t) pre-sowing seed treatment; 3 – Polydon Potassium Plus (1.0 l/ha) + Polydon Boron (0.6 l/ha) foliar feeding in the budding phase; 4 – Polydon BIO (1.5 l/ha) + Polydon NP (2.5 l/ha) fertilizing during the fruit-forming phase; 5- Polydon Potassium Plus (1.0 l/ha) + Polydon Boron (0.6 l/ha) foliar feeding in the budding phase + Polydon BIO (1.5 l/ha) + Polydon NP (2.5 l/ha) feeding in the fruit-forming phase, i.e. feeding in the budding phase and in the fruit-forming phase with the above-mentioned drugs.

Buckwheat harvesting was carried out by direct combining with pre-drying of plants with Reglon (2 l/ha) when 85% of the fruit was ripe. Crop accounting was according to plots. The results of crop accounting were processed by the method of variance analysis.

3. Research results and their discussion

The weather conditions of the growing seasons of 2016-2018 were characterized by the consistency of weather indicators for buckwheat phenophases, which could not but affect the yield level.

In 2016, buckwheat was sown on May 14 at a soil temperature of 14.6°C at a depth of 0-10 cm. Seedlings appeared on 26.05, i.e. on the 12th day after sowing, due to the fact that during this period there were seven days with rain, precipitation fell 160.5% of the decadal norm, and the average daily air temperature varied from 10.5 to 15.3°C, which is 1.1°C colder than the average long-term norm. Field germination was 85%. The vegetative period of the experimental crops took place under a relatively favorable temperature regime, but with an increased amount of precipitation (by 22.5%). The reserve of productive moisture in the 0-10 cm soil layer varied from 39 to 59 mm.

The generative period of buckwheat took place under contrasting weather conditions. The first 15 days (20.06-5.07) from the beginning of flowering in the Druzhina variety fell under a more severe temperature regime (t=27.0-30.9°C), with no precipitation (5.6% of the decadal norm) and low humidity (37-52%). A similar situation was repeated at the beginning of the third decade (from 12.07 to 18.07).

In 2017, buckwheat was sown on 11.05 at a soil temperature of 9.5°C in a layer of 0-10 cm. Seedlings appeared on May 24, field germination was 83%.

The vegetative period (24.05–17.06) took place with a lack of heat (by 0.6–2.8°C) and an increased amount of precipitation (by 185-208% of decadal norms).

During the generative period (19.06–30.07), a moderate temperature regime (the average daily air temperatures in June–July were 18.2–20.7°C) and a sufficient amount of moisture (28-58 mm in the 0-20 cm soil layer) contributed to the formation of a fairly high grain yield – 32.3 C/ha.

In 2018, buckwheat was sown on May 15, seedlings appeared on May 22, field germination was 74%. According to meteorological indicators, 2018 was marked by high air temperatures and insufficient precipitation. So, out of the four decades of the generative period, 26 days were with daytime temperatures above 25°C, which led to a strong decrease in yield (1.54 t/ha) by 0.38–1.69 t/ha. Consequently, as it was noted earlier, the formation of buckwheat yield is significantly influenced by weath-
er conditions during the flowering – ripening period [4]. The share of their influence varies from 75 to 115%.

The obtained data for 2016-2018, in such different weather conditions, contributed to an objective assessment of the effectiveness of organic and mineral fertilizers of the company “Polydon Agro” in the processing of vegetative buckwheat plants.

The results of experiments in 2018 showed that foliar fertilization with multicomponent fertilizers provided an increase in buckwheat yield even in conditions of a hard temperature regime-0.40–0.55 t/ha. Apparently, the organic substances contained in the tested fertilizers activate the protective functions of plants and restore their productivity after stress [3]. On average, in 2016-2018, the increase in the yield of buckwheat grain was 0.19–0.40 t/ha, i.e. the share of significance of this agricultural sector is in the range of 12.8–16.9% (table 1). It should be noted that the effect of organic and mineral fertilizers for foliar feeding of buckwheat in different phases of plant development on increasing yield is almost equivalent. The yield variation according to the experimental variants (on average for three years) was 2.30-2.35 t/ha, i.e. the share of the influence of the “leaf feeding period” factor is less significant – 2.8–3.4%.

Table 1. Yield and agro-economic efficiency in the use of organic and mineral fertilizers on buckwheat.

| № | Yield, t/ha/years | Yield increase | The costs of fertilizers, kg | Payback of fertilizers by increase, kg/kg | Share of fertilizers in the crop, % |
|---|------------------|----------------|------------------------------|------------------------------------------|-----------------------------------|
|   | 2016 | 2017 | 2018 | average | t/ha | % | per 1 C of yield | per 1 C of increase | kg/kg | kg/kg |
| 1* | 1.85 | 2.78 | 1.20 | 1.95 | – | – | – | – | – | – |
| 2  | 1.90 | 3.09 | 1.43 | 2.14 | 0.19 | 9.7 | – | – | – | 10 |
| 3  | 1.91 | 3.39 | 1.60 | 2.30 | 0.35 | 17.9 | 0.070 | 0.457 | 218.8 | 18 |
| 4  | 1.92 | 3.34 | 1.65 | 2.30 | 0.35 | 17.9 | 0.174 | 1.143 | 87.5 | 18 |
| 5  | 2.01 | 3.34 | 1.75 | 2.35 | 0.40 | 20.5 | 0.238 | 1.400 | 71.4 | 21 |
| HCP 0.09 0.12 0.11 |

* – 1 – control (without fertilizers); 2 – Alfastim (80 ml/t) – seed treatment; 3 – Polydon Potassium Plus (1.0 l/ha) + Polydon Boron (0.6 l/ha) – feeding in the budding phase; 4 – Polydon Bio (1.5 l/ha) + Polydon NP (2.5 l/ha) – feeding in the fruit-forming phase; 5 – Polydon Potassium Plus (1.0 l/ha) + Polydon Boron (0.5 l/ha) – feeding in the fruit-forming phase + Polidon Bio (1.5 l/ha) + Polydon NP (2.5 l/ha) – feeding in the fruit-forming phase.

Evaluation of options with the use of complex mineral fertilizers for foliar feeding of buckwheat showed their high agronomic efficiency. The payback of one kilogram of complex fertilizers by increasing the yield of buckwheat grain (kg/kg) was from 71.4 to 218.8.

It should be noted the high efficiency of the biological stimulant of plant growth Alfastim. Using it for pre–sowing seed treatment increases the yield of buckwheat grain by 0.04-0.31 t/ha, i.e. 1 ml of the drug pays off 22.5 kg of grain. Calculations have shown that single-use foliar feeding are more expensive, where the highest payback (87.5–218.8 kg/kg) of applied fertilizers is obtained.
4. Summary
As a result of three-year research (2016-2018), it was found that foliar feedings with organic and mineral fertilizers: Podion BORON, Polydon BIO, Polydon Potassium Plus, Polydon NP provide an average increase in buckwheat grain yield of 0.35–0.40 t/ha in two terms. The share of this factor influence on buckwheat yield was 12.8–16.9%, depending on the growing season.

It was found that the share of the influence of weather conditions of the growing season on the level of buckwheat yield is quite high and ranges from 75 to 115%.

Evaluation of the comparative agronomic efficiency of organic and mineral fertilizers produced by LLC Polydon Agro for leaf feeding showed that they are almost equivalent to the previously tested complex fertilizers TerraFlex (Belgium), Speedfol (South Africa), Rexolin (Netherlands) [4]. Therefore, their use for buckwheat leaf fertilization is advisable as a reserve for obtaining an additional 0.35-0.43 t/ha of buckwheat grain, which in value terms is from 4.09 to 6.02 thousand hectares, which is agroeconomically justified.

5. References
[1] Promising resource-saving technology for buckwheat production 2009 40
[2] Sokolov O A 1980 Mineral nutrition of plants (on the example of buckwheat) 193
[3] Adaptive technologies of leaf feeding 2012 30
[4] Glazova Z I 2014 Yield of new varieties of buckwheat depending on weather conditions and fertilizers (Agriculture) 4 40–42
[5] Glazova Z I 2013 Complex fertilizings for buckwheat (The Book of Abstracts 12 International Symposium on Buchwheat., Lasko, 21…25 August) 46
[6] Polukhin A A, Panarina V I 2020 Main problems of selection and seed production of agricultural crops and ways to solve them (Zernoboboye i krupyanie kul’tury) 3(35) 5-11
[7] Grudkina M, Polukhin A, Grudkina T 2019 Factors increasing the effectiveness of state support in agriculture (IOP Conference Series: Earth and Environmental Science) 274 012113
[8] Hamitowa S M, Glinushkin A P, Avdeev Y M, Naliukhin A N, Kostin A E, Kozlov A V, Uromova I P, Rudakov V O, Tesalovskiy A A, Protopopova E V, Pigorev I Y, Polukhin A A, Sycheva I I 2017 Condition Assessment Of Tree Plantations and Phytosanitary Properties of Soils in Cedar Groves (International Journal of Pharmaceutical Research & Allied Sciences) 6(4) 1-7
[9] Medvedev A V 2020 Improving the innovative and entrepreneurial potential of irrigated agriculture in the South of Russia (Russian Economic Bulletin) 3 (3) 149-153
[10] Bayanova O V 2020 Mechanism for ensuring the growth of feed crop production (Russian Economic Bulletin) 3 (1) 124-127
[11] Polukhin A A, Alekseev K I, Ryzhkova S M, Kruchinina V M, Stavtsev A N, Lankin A S 2019 Economic Evaluation of Directions of State Support of Producers of Energy Capacities for Agriculture of Russia (International Journal of Engineering and Advanced Technology (IJET)) 9 (1) 5013-5017