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INTEGRATED APPLICATION OF PLANT GROWTH REGULATOR AND VARIETIES ON WEED INFESTATION: SUSTAINABLE PRODUCTIVITY OF WHEAT IN RUSSIA

Research article

Okbagabir S.G.[1, *], Saquee F.S.[2], Pakina E.N.[3], Zargar M.[4], Aldaibe A.A.[5], Kholomyeva L.N.[6]
[1] ORCID : 0009-0006-8937-9230;
[2] ORCID : 0000-0001-7653-6942;
[3] ORCID : 0000-0001-6493-6121;
[4] ORCID : 0000-0002-5208-0861;
[1, 2, 3, 4, 5] Peoples' Friendship University of Russia named after Patrice Lumumba, Moscow, Russian Federation
[6] All-Russian Research Institute of Agrochemistry named after. D.N. Spicy, Moscow, Russian Federation

* Corresponding author (shimendigde[at]gmail.com)

Abstract

The effect of varieties and growth regulator (GR) is crucial for optimizing wheat production and increasing the plant's ability to tolerate weed suppression. The study was carried out in Agrochemistry in Barybino, Moscow, in 2023 and 2024, aiming to suppress weed ability and enhance crop growth and productivity. Eight treatment combinations, namely wheat varieties, kanyuk (V1) and Radmira (V2), and four different dosages of GR: control-0 (GR0), Centrino-1 (GR1), Centrino-2 (GR2), and Centrino-3 (GR3), were laid out in three replications for the field experiment, in an RCBD design. V2 and GR3 recorded significantly the highest weed control efficiency of 53.07% and 67.90%, respectively. It was attributed to reduced weed density and weed biomass of V2 with a mean value of 21.13 and 11.4g, and weed density of GR1 was attained with a value of 16.08 at the maturity stage. V2 significantly obtained the highest grain yield (4172.52 kg ha^{-1}). However, V1 wheat varieties yielded a significant maximum biological yield (12229.43 kg ha^{-1}) and 1000 grain weight (32.57 g). The interaction effect of V1GR1 showed significantly the highest grain yield, biological yield, and 1000 grain yield of 4802.67 kg ha^{-1}, 16803.47 kg $ha^{-1}$and 41.12 g, respectively. However, V1GR0 obtained the lowest root length, productive tiller, grain yield, biological yield, and 1000 grain yield of 7.77 cm, 1.7, 3046.66 kg ha-1, 9040 kg ha-1, and 29.67 g, respectively. Integrating the application of different GR dosages with selected wheat varieties contributes valuable insights for farmers and agronomists seeking sustainable solutions to enhance crop performance to face weed challenges.

Keywords: growth regulator, integration, varieties, weeds, wheat, yield.

КОМПЛЕКСНОЕ ПРИМЕНЕНИЕ РЕГУЛЯТОРОВ РОСТА РАСТЕНИЙ И СОРТОВ ДЛЯ БОРЬБЫ С СОРНЯКАМИ: ПОВЫШЕНИЕ УРОЖАЙНОСТИ ПШЕНИЦЫ В РОССИИ

Научная статья

Окбагабир Ш.Г.[1, *], Саке Ф.С.[2], Пакина Е.Н.[3], Заргар М.[4], Алдайбе А.А.[5], Холомьева Л.Н.[6]
[1] ORCID : 0009-0006-8937-9230;
[2] ORCID : 0000-0001-7653-6942;
[3] ORCID : 0000-0001-6493-6121;
[4] ORCID : 0000-0002-5208-0861;
[1, 2, 3, 4, 5] Российский университет дружбы народов имени Патриса Лумумбы, Москва, Российская Федерация
[6] Всероссийский научно-исследовательский институт агрохимии им. Д.Н. Прянишникова, Москва, Российская Федерация

* Корреспондирующий автор (shimendigde[at]gmail.com)

Аннотация

Влияние сортов и регулятора роста (ГР) имеет решающее значение для оптимизации производства пшеницы и повышения способности растения переносить подавление сорняков. Исследование проводилось в Агрохимии в Барыбино, Москва, в 2023 и 2024 годах с целью подавления способности сорняков и повышения роста и продуктивности сельскохозяйственных культур. Восемь комбинаций обработки, а именно сорта пшеницы, канюк (V1) и Радмира (V2), и четыре различные дозировки ГР: контроль-0 (GR0), Центрино-1 (GR1), Центрино-2 (GR2) и Центрино-3 (GR3), были заложены в трех повторностях для полевого эксперимента в дизайне RCBD. V2 и GR3 зафиксировали самую высокую эффективность контроля сорняков 53,07% и 67,90% соответственно. Это было связано с уменьшением плотности сорняков и биомассы сорняков V2 со средним значением 21,13 и 11,4 г, а плотность сорняков GR1 была достигнута со значением 16,08 на стадии созревания. V2 значительно получил самую высокую урожайность зерна (4172,52 кг га-1). Однако сорта пшеницы V1 дали значительную максимальную биологическую урожайность (12229,43 кг га-1) и массу 1000 зерен (32,57 г). Эффект взаимодействия V1GR1 показал значительно самую высокую урожайность зерна, биологическую урожайность и урожайность 1000 зерен 4802,67 кг га-1, 16803,47 кг га-1 и 41,12 г соответственно. Однако V1GR0 показал наименьшую длину корня, продуктивную поросль, урожайность зерна, биологическую урожайность и урожайность 1000 зерен 7,77 см, 1,7, 3046,66 кг га-1, 9040 кг га-1 и 29,67 г соответственно. Интеграция применения различных дозировок GR с выбранными сортами пшеницы дает ценные идеи фермерам и агрономам, ищущим устойчивые решения для повышения урожайности культур в борьбе с сорняками.

Ключевые слова: регулятор роста, интеграция, сорта, сорняки, пшеница, урожайность.

Introduction

Wheat (Triticum aestivum L.) is the truly extensively cultivated cereal crop. Yield reached from 732.1 to 760.9 million tons, including a total area of 213.9 to 219.0 million hectares. The four foremost wheat-producing countries globally in the 2020–2021 season were China (134.3 million tonnes), India (107.6 million tonnes), Russia (85.9 million tonnes), and the USA (49.7 million tonnes) [5]. Weeds are plants that proliferate in unsuitable locations, compete with cultivated crops, or obstruct human activity in various manners. Weeds are counted the primary biotic impediment to agricultural production, subsequent in yield losses of 45–95%, contingent upon environmental conditions and agronomic techniques. Consequently, sustaining food grain production to nourish the growing global population and enhancing the genetic yield potential of crops is significantly reliant on effective weed management [9].

Although most farmers recognize the problem of weeds in their fields, there frequently exists insufficient labor to manage significant weed infestations during the critical phase of the cropping season. In the subcounty, most of their fields are either neglected in terms of weeding or are weeded belatedly. Weed competition in agricultural systems increasingly presents challenges; hence, carefully adopting GR and optimizing variety interaction are essential for mitigating weed infestation while sustaining yields [2]. The primary obstacle hindering crop output in Ethiopia and Eritrea is the invasion of weeds, particularly during the rainy season [8].

Plant secondary metabolites (PSM) may be reduced or increased because of GR treatment's ability to modify plant metabolism. According to [10] report, a great deal of attention has been focused on developing and using new-generation GRs with a wide range of physiological activities. Numerous plant growth regulators can be utilized to enhance root formation and growth as well as regulate key cellular functions, according to research by [17]. Growth regulators function by requiring the activation of physiological and biochemical processes, hence increasing the absorption concentration of nutrients and mineral compounds found in soil clusters [4]. Different types respond differently to their input requirements, variety is thought to be the most significant element of management strategies. A degree of proper plantation is to protect against agricultural pest invasion, specifically, the absence of weed competition, substantially impacts crop plants' yield [12]. Certain characteristics, such as taller plants, larger flag leaves, larger leaf sizes and leaf area indices, high specific leaf area during vegetative growth, and allelopathic abilities, distinguish one variety from another and make it more competitive with weeds [3]. Considering the above given facts, the current study aimed to diminish weed proliferation and enhance crop growth and production through the use of select spring wheat varieties and variable glyphosate dosages within a sustainable agricultural framework.

Methodologies and principles of research work

2.1. Overview of the research area

The experiment was carried out at the Research Institute of Agrochemistry in Barybino, Domodedovo Microdistrict, Moscow, between 2023 and 2024, at a latitude of 55° 15' 53.6248" N, longitude of 37° 52' 13.1712" E, and an elevation of 137 meters above sea level. The seed was seeded in May during both growth seasons at a seeding rate of 220 kg ha^{-1}, and germination occurred 5-7 days after planting (DAP). Two spring wheat varieties, Kanyuk (V1) and Radmira (V2), along with the growth regulator Centrino, which includes non-treatment (GR0), Centrino-1 (GR1), Centrino-2 (GR2), and Centrino-3 (GR3), contain the active ingredient chlormequat chloride at a concentration of 750 g/l and are formulated as a water-soluble concentrate, functioning through contact action. GR was applied once, during the tube phase, at rates of 0.0, 1.0, 1.25, and 1.5 l ha^{-1}, with a working fluid flow rate of 300 l ha^{-1}.

Soft spring wheat, Buzzard (kanyuk), type, which is bred via crossing and then released through individual-family selection and released in Russiaas presented in (Table 1), Voronezh region, Liskinsky district, Shchuchye village, Sovetskaya street, 33. The straw is poorly made with the wax coating on the ear is medium strong, and the sheath of the flag leaf is also strong, with medium internode. The spike is spindle-shaped, of medium density, white. The osteoid processes at the end of the ear are very short [1].

Radmira (L. 403/2 – 12 H 2754) is a spring soft wheat variety that was developed at the Federal State Budgetary Scientific Institution "Federal Research Center "Nemchinovka"" in Russia. The General Radmira type has a medium length straw. Both the flag leaf's sheath and the straw's upper internode are weak to medium. At the end of the ear, the osteoid processes are brief. The variety is listed in the State Register of Breeding Achievements as of [14].

Table 1 - The characteristics description of Kanyuk and Radmira varieties

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Varieties characteristics	Soft spring wheat, Buzzard (KANYUK) variety	Soft Spring wheat variety Radmira
Variety description	Belvoir x [(Mexican x sappo) Socrates]	[varieties Zlata x Ester]
Pedigree of Ripeness group the variety	Mid-season variety	Mid-season variety
Vegetation period, days	76-99	77-98
Weight 1000 grains, g	37-46	40-42
Productivity t/ha	3.81-7.04	3.32-6.5
Regionalization	Akmola, Kostanay, and North	Volga-Vyatka (4) region and

	Kazakhstan	Nizhny Novgorod region

2.2. Designs of the experimental layout

The region was cultivated with a disc harrow and a disc plow. A randomized complete block design (RCBD) was utilized in the field, with three replications implemented in the experiment. Each replication had eight treatments arranged in a plot size of 5 m × 2 m, with a spacing of 14 cm between rows, 4 cm between plants within rows, 0.5 m between plots, and 1 m between blocks. The crops were harvested from August 6 to August 13.

2.3. Collected Data:

2.3.1. Flora of weeds

Weed populations were enumerated during the tillering stage, during the vegetative phase, and fifteen days before harvest, just before the application of GR. A quadrat (m^2) was randomly sampled three times in each plot to quantify and enumerate the weeds. The samples were subsequently dried in an oven at 700°C.

2.3.2. Weed Control Efficiency (WCE%)

Weeds were randomly extracted from the 0.25 m^2 net plot area and subsequently oven-dried at 70°C until a stable weight was achieved. The weights of the desiccated weeds were recorded. The formula from [13] was employed to calculate the WCE percentage.

$$WCE(\%) = \frac{DMWut - DMWt}{DMWut} \times 100 \quad (1)$$

DMWut represents the dry matter of weeds from untreated or weedy check plots, DMWt denotes the dry matter of weeds from treated plots or those subjected to a specific treatment, and WCE% indicates weed control efficiency.

2.3.3. Growth factors, yield, and components of yield

Plant height, root length, and viable tiller were assessed from randomly selected samples. Five plants were selected randomly, enumerated, and the average was calculated. The net plot size of each plot was measured, and the weight (g) of the net plot was recorded for thousand-grain weight, grain yield, and biological yield.

2.3.4. Relative loss on yield (%)

The yield loss was computed as a percentage of the disparity between the yield in each treatment and the yield in the control (no treatment applied) as per [15].

$$RYL = \frac{Y1 - Y2}{Y1} \times 100 \quad (2)$$

Relative Yield Loss (RYL), yield (Y1) from completely weed-free plots, and yield (Y2) from treated plots constitute.

2.3.5. Statistical analysis

Collected parametric data were analyzed using IBM SPSS Statistics v23x64 software. Mean separation tests utilized Fisher's protected Least Significant Difference (LSD) to distinguish differences among treatment means at a five percent significance level.

Results and Discussions

3.1. The effects of Varieties and Growth regulator on weed characters

3.1.1. Weed flora

The experimental field of spring wheat crops contains a diverse array of weed species. The predominant weed species identified in the experimental area included field bindweed (*Convolvulus arvensis*), wild mustard (*Sinapis arvensis*) foliage, catch weed (*Galium aparine*) foliage, Canada thistle (*Cirsium arvense*) plant(s), pineapple-weed (*Matricaria discoidea*) flower(s), and Buckhorn plantain (*Plantago lanceolata*) were found to have abundant foliage. In this experimental trial field, buckhorn plantain grows the lowest weed populations (2-3 no m^{-2}) relative to the other weed species, whereas bindweed, wild mustard, and pineapple weed demonstrated considerably the largest populations with 6, 10, and 13 no m^{-2}, respectively were obtained in V1GR0 treatment with no o application of GR. The application of growth regulators and resistant types, however, reduced and less suppressed the weed infestation, as seen by the results in (Table 2), and as a result, the population at the vegetative and maturity stages dramatically dropped.

3.1.2. Weed population(m^2)

An analysis of variance revealed a statistically significant difference in weed control efficiency at $P<0.05$, attributed to the effects of wheat cultivars and GR, as presented in (Table 2). Three phases of weed count experiments were conducted: during tillering, before to the use of GR, throughout the vegetative stage, and at maturity. The sample from V1 exhibited the highest weed density at 50.75 individuals per square meter (no m^{-2}), whereas V2 recorded the second-highest density at the tillering phases, with 48.79 no m^{-2}. The minimum weed density recorded was 16.08 no m^{-2}during the maturity stages for GR1. The interaction effect illustrated in (Figure 2) indicates that V1GR0 exhibited statistically significant maximum weed densities at the tillering, vegetative, and maturity stages, with values of 51.6, 54, and 47 no m^{-2}, respectively. Conversely, the lowest weed densities were recorded in V2GR1 and V2GR3, which were statistically comparable, with numerical values of 12.67 no $m^{-2}$and 14.33 no m^{-2}, respectively, at the maturity stage when interacting with growth regulators. In line to these studies the most significant weed impact was seen in the BARI Gom 22 type (69.92%), whereas the least was noted in BARI Gom 24 (49.51%) [6].

3.1.3. Weed biomass (g m^{-2})

The analysis of variance depicted in (Figure 1) indicates a significant difference in weed dry biomass ($P < 0.05$) among all treatments. The results indicated a substantial decrease in weed biomass across different GR treatment rates in wheat cultivars. In comparison to GR0 (control) at 28.17 g m^{-2}, GR3 exhibited the lowest weed dry biomass, succeeded by GR1 at 9.07 g $m^{-2}$and GR2 at 9.60 g m^{-2}, respectively. At crop maturity, V2 exhibited a much lower weed density than V1, with mean values of 11.41 g $m^{-2}$and 17.17 g m^{-2}, respectively. The impact of cultivars and GR in (Figure 1) demonstrated a considerable difference in weed biomass. The V1 interaction with untreated (V1GR0) weeds resulted in the highest weed biomass of 32 g m^{-2}. The lowest weed biomass was seen in V2GR1, succeeded by V2GR3, with mean values of 6.2 and 7.13 g m^{-2}, respectively. In accordance with these findings, local wheat accompanied by weedy check plots exhibited the highest weed dry biomass of 24.41 g m^{-2}. Subsequently, enhanced durum wheat cultivars from Utuba and Mangudo exhibited weed control treatments yielding 19.87 and 18.31 g $m^{-2}$of weed dry biomass, respectively [11].

Table 2 - Effect of GR and varieties on weed density, Biomass, and control efficiency

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Treatments	Weed count at Tillering stage (m^2)	Weed count at Vegetative stage (m^2)	Weed count at Maturity stage (m^2)	Weed Biomass (g m^{-2})	Weed control Efficiency (%)
Varieties					
V1	50.75	37.08	26.38	17.17	46.33
V2	48.79	27.96	21.13	11.41	53.07
Mean	49.77	32.52	23.75	14.29	49.70
LSD	7.34	13.24	14.22	8.00	28.30
SE	2.97	2.5	2.02	0.70	1.69
Growth regulators					
GR0	49.08	50.50	45.00	28.17	0.00
GR1	47.58	25.92	16.08	9.60	66.85
GR2	52.67	27.75	16.92	10.31	64.06
GR3	49.75	25.92	17.00	9.07	67.90
Mean	49.77	32.52	23.75	14.29	49.70
LSD	8.01	12.78	13.48	8.88	30.07
SE	2.97	2.50	2.00	0.76	2.39

3.1.4. Weed control efficiency (WCE %)

The analysis of variance revealed that the effect of GR on wheat types resulted in significantly different weed control efficiency at P<0.05, as measured by (eq.1). Among all growth regulator doses, GR3 had the best weed control efficacy at 67.9%, succeeded by GR1 at 66.8 %. In comparison to V1, V2 had the highest weed control efficiency (WCE) at 53.07%, whilst the control group (GR0) demonstrated the lowest WCE at 0.0% relative to the weedy check treatments. According to these data, untreated local wheat exhibited the lowest weed control effectiveness (0.0%), whereas the improved durum wheat variety combined with weedy check treatments had the best weed control efficiency (53.07%) [6].

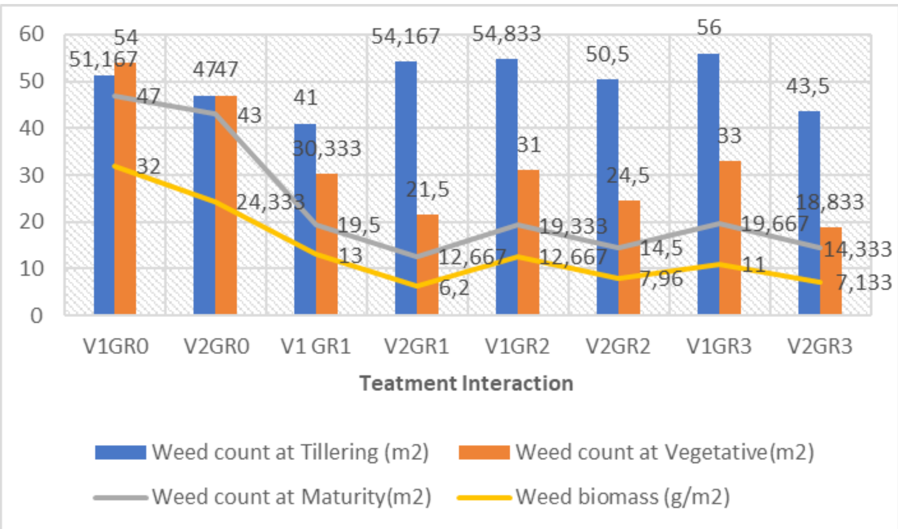

Figure 1 - Interaction effect of GR and wheat varieties on weed parameters

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3.2. Effects of growth regulators and varieties on growth characters of spring wheat

The effects of growth regulators and types of spring wheat on growth metrics are presented in (Table 3) and (Figure 2). A preliminary examination of the scientific research on growth parameter investigations was significantly influenced by all treatments.

3.2.1. Plant height (cm)

A statistically significant difference in plant height (PH) at P<0.05 was observed due to the influence of wheat cultivars and GR, as illustrated in (Table 3). The findings indicated that the growth regulator with inhibitory properties significantly reduced plant height. The highest plant height, V2, was recorded at 73.70 cm, while V1 had the lowest mean height of 63.13 cm. Data indicates that GR1 had the highest PH by a significant margin, succeeded by GR2, with mean values of 73.00 cm and 70.15 cm, respectively. The interaction between types and GR exhibited a considerable variation in PH, as seen in (Figure 2). V2GR2 and V2GR1 exhibited statistically significant equivalence, recording the highest values in PH at 79.6 cm and 78.5 cm, respectively. Nonetheless, V1GR1 had the lowest performance in PH during the testing phases. Our findings align with those indicating a significant interaction effect on plant height between bacterial strains and NP levels [7].

3.2.2. Root length (cm)

The analysis reveals that the combination of a growth regulator and weed control strategies substantially influenced root length (RL) at P<0.05, as presented in (Table 3). In comparison to varieties V2 showed significantly maximum root lengths attained in field-treated experimental plots with mean value of 10.49, while V1 obtained less with 8.57 cm. The longest root length, measuring 9.88 cm, was achieved by GR2 among all GR applications. Nevertheless, GR3 achieved the minimal root length, with a mean value of 8.57 cm. The interaction effect findings of V2GR0 and V2GR3 were comparable, with the maximum root lengths recorded at 12 cm and 11.3 cm, respectively; nevertheless, V2GR0 exhibited the longest root length.

3.2.3. The number of fertile tillers (NFT) per plant (No)

The findings indicated a significant relationship of wheat types and GR at P<0.05 in (Table 3). In comparison to V1 (2.12), V2 (2.57) exhibited a significantly higher number of productive tillers. GR1 exhibited the maximum number of productive tillers among all growth regulator rates, succeeded by GR3 with mean values of 2.65 and 2.63, respectively. In the interaction effect of the treatments depicted in (Figure 2), V2GR3 achieved a considerably superior fertile tiller count of 3.07. The minimum reported value was 1.7 for V1GR0. Consistent with the data published by [13], Utuba durum wheat in completely weed-free plots yielded 4.33 total productive tillers.

3.3. Impact of Growth Regulators and Varieties on Spring Wheat Yield and Yield Components

The data on the impacts of Varieties and Growth Regulator on yield and yield components, as presented in (Table 3) and (Figure 3), indicate a statistically significant influence at (P<0.05) on 1000 Grain Weight (TGW), Grain Yield (GY), and Biological Yield (BY).

3.3.1. 1000-grain weight (g)

The analysis of variance (Table 2) and Figure 3 indicate that wheat varieties, growth rate (GR), interactions, and GR significantly influenced thousand-grain weights at P<0.05. According to the stated results, V2 and GR1 achieved the maximum TGW, followed by GR2, while V1 and the non-treated group (GR0) recorded the lowest TGW values of 33.37 g, 35.36 g, 35.27 g, 32.57 g, and 29.08 g, respectively. The interaction effects indicated that V1GR1 exhibited the highest thousand-grain weight (41.66 g), whereas V2GR0 recorded the lowest thousand-grain weight (35.66 g) across both developing phases.

3.3.2. Grain yield (kg ha^{-1})

Throughout all experimental periods, a significant difference was seen in the effects of wheat types, GR, and their interaction on grain yield at P <0.05, as illustrated in (Table 3). V2 achieved the maximum grain yield of 4172.52 kg ha^{-1}. GR1 produced the highest grain output among all growth regulators (4498.33 kg ha^{-1}), whereas GR0 resulted in the lowest yield (3275.77 kg ha^{-1}). Besides the interaction impact of wheat types and GR dosages, V1GR1 had the highest grain production (4802.67 kg ha^{-1}) relative to other treatments. Decreased yield occurred due to weeds competing with wheat crops for nutrients, oxygen, water, sunshine, and space. The maximum grain production was achieved due to an increased number of grains per spike and a greater total and effective tiller count per hill. An environment devoid of weeds enabled the crop to absorb moisture, nutrients, and sunlight more effectively, hence enhancing yield. As per [13], the enhancement in grain yield within a 1-square meter area was noted at 26.5% and 31% for treatments T1 and T2, respectively, relative to the control group. Our discovery aligns with the outcomes of our inquiry.

3.3.3. Biological Yield (kg ha^{-1})

The findings shown in (Table 3) on the effect of GR and the interaction between Varieties and GR on biological yield at P< 0.05 demonstrated a significant impact, although no notable differences in biological yield were seen across the varieties. In V2, the completely weed-free plots yielded the highest biological output of 12229.43 kg ha^{-1}and 12317.63 kg ha^{-1}, respectively, in V1. The untreated (GR0) yield of 3275.77 kg ha^{-1}exhibited the lowest biological yields, whereas the highest yields were recorded in GR1 at 4498.33 kg ha^{-1}. In comparison to other treatments, the plots exhibiting the interaction of V1GR1 demonstrated the highest biological yields (16803.47 kg ha^{-1}). The results obtained are considered appropriate for dependence on the growth regulators of wheat phenological phases, yield, and yield components. The results were attributable to the favorable performance of all growth characteristics and yield parameters throughout the specified growing seasons in (Table 3).

Table 3 - Effect of GR and Varieties on Growth and Yield parameters of spring Wheat

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Treatments	Plant height (cm)	Root length (cm)	Number of fertile tillers per plant (No)	Grain yield (kg ha^{-1})	Biological yield (kg ha^{-1})	1000 grain weight(g)

Varieties						
V1	63.13	8.57	2.12	3706.30	12317.63	33.37
V2	73.70	10.49	2.57	4172.52	12229.43	32.57
Mean	68.42	9.53	2.34	3939.41	12273.53	32.97
LSD	6.63	1.49	0.55	424.22	NS	NS
SE	0.94	0.26	0.10	222.19	608.35	1.7
Growth regulators						
GR0	64.17	9.55	1.76	3275.77	9396.80	29.08
GR1	73.00	10.08	2.65	4498.33	14785.53	35.36
GR2	70.15	9.88	2.33	4217.53	14785.53	35.27
GR3	66.35	8.57	2.63	3766.00	11735.87	32.167
Mean	68.42	9.53	2.34	939.41	12675.93	32.97
LSD	7.63	1.59	0.53	844.94	2184.00	5.33
SE	1.33	0.36	0.14	222.19	608.35	1.70

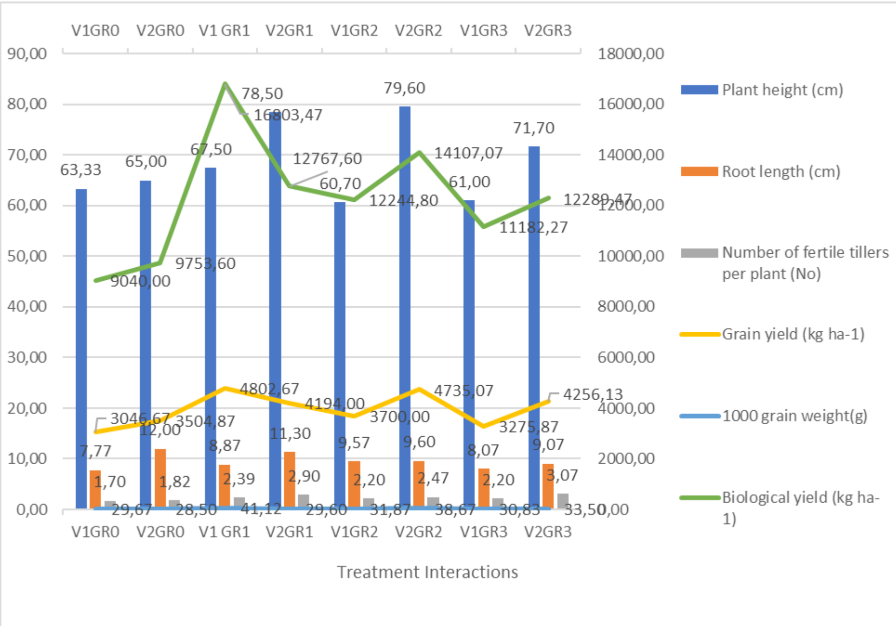

Figure 2 - Interaction effect of GR and Varieties on growth and yield parameters of spring wheat

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3.3.4. Relative grain yield loss (RYL %)

(Figure 3) illustrates the effect of Varieties and GR on relative grain yield loss (RYL), calculated using equation 2 at a significance level of P< 0.05. Out of the two-way interaction effects, V1 yielded the largest relative grain yield loss (RYL) of 24.68%, whereas V2 yielded the lowest relative grain yield loss. Throughout the experimental trials, GR0 (33.43%) produced the largest RYL among the application of various dose growth regulators, whereas GR1 (8.58%) produced a negligible loss. It illustrated that wheat and other small-grain crops were administered a normal dosage of plant growth regulators, essential for mitigating crop lodging and enhancing biomass and root length. Based on these findings, wheat, and other small grain crops, which are crucial in mitigating crop lodging, were administered a typical dosage of plant growth regulators [16].

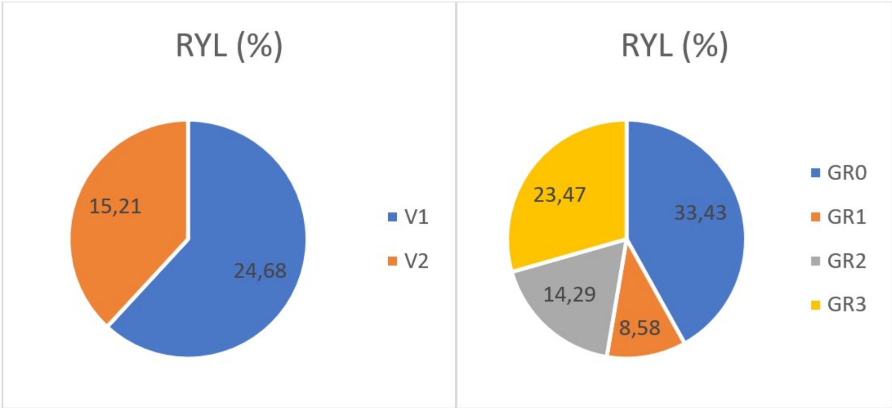

Figure 3 - Effect of GR and Varieties (*V*) on relative yield loss (*RYL%*) of spring wheat

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Conclusion

The investigation's findings indicated substantial potential for weed management in wheat varieties via varietal selection and the use of growth regulators. Research on the effects of growth regulators and spring wheat varieties indicates that V1GR1 had the highest grain output (4802.67 kg ha^{-1}, 16803.47 kg ha^{-1}, and 41.12 g) and the greatest biological yield (4802.67 kg ha^{-1}). The results of these studies clearly demonstrated that, in comparison to untreated wheat (V1GR0), the V1GR1 and V2GR2 treatments were more successful in decreasing overall weed density and collecting less dry matter weight. The integration of several wheat varieties and varied glyphosate-resistant doses has demonstrated efficacy as a cost-effective and ecologically sustainable weed control strategy. Ultimately, by markedly reducing weeds infestation observed in this integration experiment.

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Конфликт интересов

Не указан.

Рецензия

Все статьи проходят рецензирование. Но рецензент или автор статьи предпочли не публиковать рецензию к этой статье в открытом доступе. Рецензия может быть предоставлена компетентным органам по запросу.

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Conflict of Interest

None declared.

Review

All articles are peer-reviewed. But the reviewer or the author of the article chose not to publish a review of this article in the public domain. The review can be provided to the competent authorities upon request.

Список литературы / References

1. Афонин Н.М. Оценка сортов яровой пшеницы, используемых в тамбовской области / Н.М. Афонин, А.А. Опритов, Т.А. Полякова // Наука и образование. — 2023. — № 1.
2. AGRIS The International System for Agricultural Science and Technology. — 2022.
3. Bertholdsson N.O. A century of Nordic barley breeding-Effects on early vigour root and shoot growth, straw length, harvest index and grain weight / N.O. Bertholdsson, A. Kolodinska Brantestam // European Journal of Agronomy. — 2009 — № 30 (4). — DOI: 10.1016/j.eja.2008.12.003.
4. Espindula M.C. Use of growth retardants in wheat / M.C. Espindula [et al.] // Planta Daninha. — 2009. — № 27 (2).
5. Gultyaeva E. Virulence Diversity of Puccinia striiformis f. sp. Tritici in Common Wheat in Russian Regions in 2019–2021 / E. Gultyaeva, E. Shaydayuk, E. Kosman // Agriculture (Switzerland). — № 12 (11). — DOI: 10.3390/agriculture12111957.
6. Islam S. Effect of Cultivar and Seed Rate on Weed Infestation and Crop Performance of Wheat / S. Islam, M. Salim, M.S.K. Azad [et al.] // Research in Agriculture Livestock and Fisheries. — 2022. — № 8 (1). — DOI: 10.3329/ralf.v8i1.53260.
7. Hussain M. Bacteria in combination with fertilizers improve growth, productivity, and net returns of wheat (Triticum aestivum L.) / M. Hussain [et al.] // Pak J Agric Sci. University of Agriculture. — 2016. — № 53 (3) — P. 633–645.
8. Jeyabalasingh P.M. Pests and diseases diagnostic mobile tool “m-WHEAT” for wheat crop in Ethiopia / P.M. Jeyabalasingh, L. Velmurugan, D.T. Shenkuta [et al.] // Journal of Agricultural Informatics. — 2017. — № 8 (2). — DOI: 10.17700/jai.2017.8.2.380.
9. Kaur R. Soil properties and weed dynamics in wheat as affected by rice residue management in the rice-wheat cropping system in south asia: A review / R. Kaur, S. Kaur, J.S. Deol [et al.] // Plants. — 2021. — № 10 (5). — DOI: 10.3390/plants10050953.

10. Kurdyukov Yu.F. Winter and spring wheat yield depending on type of crop rotations and forecrops in the arid steppe of the Volga region / Yu.F. Kurdyukov [et al.] // Russ Agric Sci. — 2012. — № 38 (1).

11. Mengist Y. Response of Durum Wheat Varieties and Weeding Frequency on Weed Infestation, Yield and Yield Component of Wheat / Y. Mengist [et al.] // Respons of drum wheat varieties and weeding frequency on weed infestation, yield, and yield componet of wheat. — 2021. — № 9 (2). — P. 49–55.

12. Miller Z.J. Winter annual grassy weeds increase over-winter mortality in autumn-sown wheat / Z.J. Miller, F.D. Menalled, M. Burrows // Weed Research. — 2013.— № 53 (2). — DOI: 10.1111/wre.12007.

13. Nasir M. Significance of Plant Growth Regulators (PGR's) on Wheat Crop Growth and Yield / M. Nasir, M. Ameen Ahmad, S. Hussain [et al.] // Science Journal of Chemistry. — 2019. — № 7 (5). — DOI: 10.11648/j.sjc.20190705.12.

14. Priyatkin N.S. Assessment of Diversity and Latent Defectiveness of Wheat Seeds (Triticum aestivum L.) instrumental physical methods / N.S. Priyatkin, M.V. Arkhipov, P.A. Shchukina [et al.] // Agricultural Biology. — 2022. — № 57 (5). — P. 911–920.

15. Sharma R. Effect of micronutrients on protein content and productivity of wheat (Triticum aestivum L.) / R. Sharma, A. Agarwal, S. Kumar // Vegetos. — 2008. — № 21 (1).

16. Thakur O. Recent advances of plant growth regulators in vegetable production: A review / O. Thakur // ~ 1726 ~ The Pharma Innovation Journal. — 2022. — № 11 (3).

17. Yakhin O.I. Protective role of bioregulator stifun under the negative effect of cadmium / O.I. Yakhin [et al.] // Russ Agric Sci. Allerton Press. — 2007. — № 33 (4). — P. 233–235.

Список литературы на английском языке / References in English

1. Afonin N.M. Ocenka sortov jarovoj pshenicy, ispol'zuemyh v tambovskoj oblasti [Determination of spring wheat varieties most suitable for use in the tambov region] / N.M. Afonin, A.A. Opritov, T.A. Poljakova // Nauka i obrazovanie [Science and Education]. — 2023. — № 1. [in Russian]

2. AGRIS The International System for Agricultural Science and Technology. — 2022.

3. Bertholdsson N.O. A century of Nordic barley breeding-Effects on early vigour root and shoot growth, straw length, harvest index and grain weight / N.O. Bertholdsson, A. Kolodinska Brantestam // European Journal of Agronomy. — 2009 — № 30 (4). — DOI: 10.1016/j.eja.2008.12.003.

4. Espindula M.C. Use of growth retardants in wheat / M.C. Espindula [et al.] // Planta Daninha. — 2009. — № 27 (2).

5. Gultyaeva E. Virulence Diversity of Puccinia striiformis f. sp. Tritici in Common Wheat in Russian Regions in 2019–2021 / E. Gultyaeva, E. Shaydayuk, E. Kosman // Agriculture (Switzerland). — № 12 (11). — DOI: 10.3390/agriculture12111957.

6. Islam S. Effect of Cultivar and Seed Rate on Weed Infestation and Crop Performance of Wheat / S. Islam, M. Salim, M.S.K. Azad [et al.] // Research in Agriculture Livestock and Fisheries. — 2022. — № 8 (1). — DOI: 10.3329/ralf. v8i1.53260.

7. Hussain M. Bacteria in combination with fertilizers improve growth, productivity, and net returns of wheat (Triticum aestivum L.) / M. Hussain [et al.] // Pak J Agric Sci. University of Agriculture. — 2016. — № 53 (3) — P. 633–645.

8. Jeyabalasingh P.M. Pests and diseases diagnostic mobile tool "m-WHEAT" for wheat crop in Ethiopia / P.M. Jeyabalasingh, L. Velmurugan, D.T. Shenkuta [et al.] // Journal of Agricultural Informatics. — 2017. — № 8 (2). — DOI: 10.17700/jai.2017.8.2.380.

9. Kaur R. Soil properties and weed dynamics in wheat as affected by rice residue management in the rice-wheat cropping system in south asia: A review / R. Kaur, S. Kaur, J.S. Deol [et al.] // Plants. — 2021. — № 10 (5). — DOI: 10.3390/plants10050953.

10. Kurdyukov Yu.F. Winter and spring wheat yield depending on type of crop rotations and forecrops in the arid steppe of the Volga region / Yu.F. Kurdyukov [et al.] // Russ Agric Sci. — 2012. — № 38 (1).

11. Mengist Y. Response of Durum Wheat Varieties and Weeding Frequency on Weed Infestation, Yield and Yield Component of Wheat / Y. Mengist [et al.] // Respons of drum wheat varieties and weeding frequency on weed infestation, yield, and yield componet of wheat. — 2021. — № 9 (2). — P. 49–55.

12. Miller Z.J. Winter annual grassy weeds increase over-winter mortality in autumn-sown wheat / Z.J. Miller, F.D. Menalled, M. Burrows // Weed Research. — 2013.— № 53 (2). — DOI: 10.1111/wre.12007.

13. Nasir M. Significance of Plant Growth Regulators (PGR's) on Wheat Crop Growth and Yield / M. Nasir, M. Ameen Ahmad, S. Hussain [et al.] // Science Journal of Chemistry. — 2019. — № 7 (5). — DOI: 10.11648/j.sjc.20190705.12.

14. Priyatkin N.S. Assessment of Diversity and Latent Defectiveness of Wheat Seeds (Triticum aestivum L.) instrumental physical methods / N.S. Priyatkin, M.V. Arkhipov, P.A. Shchukina [et al.] // Agricultural Biology. — 2022. — № 57 (5). — P. 911–920.

15. Sharma R. Effect of micronutrients on protein content and productivity of wheat (Triticum aestivum L.) / R. Sharma, A. Agarwal, S. Kumar // Vegetos. — 2008. — № 21 (1).

16. Thakur O. Recent advances of plant growth regulators in vegetable production: A review / O. Thakur // ~ 1726 ~ The Pharma Innovation Journal. — 2022. — № 11 (3).

17. Yakhin O.I. Protective role of bioregulator stifun under the negative effect of cadmium / O.I. Yakhin [et al.] // Russ Agric Sci. Allerton Press. — 2007. — № 33 (4). — P. 233–235.