Pesquisa Agropecuária Brasileira

ISSN 1678-3921

Journal homepage: www.embrapa.br/pab

For manuscript submission and journal contents, access: www.scielo.br/pab

Crop Science/ Original Article

Yield potential of modern soybean cultivars under high and low input levels

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Received
January 31, 2021

Accepted
April 05, 2022

How to cite
TONATTO, M.; ZDZIARSKI, A.D.; MEIRA, D.; PANHO, M.C.; ZANELLA, R.; MENEGAZZI, C.P.; COLONELLI, L.L.; FERNANDES, R.A.T.; CAMPAGNOLLI, O.R.; BENIN, G. Yield potential of modern soybean cultivars under high and low input levels. **Pesquisa Agropecuária Brasileira**, v.57, e02852, 2022. DOI: https://doi.org/10.1590/S1678-3921.pab2022.v57.02852.

Abstract – The objective of this work was to evaluate the grain yield potential of modern soybean (*Glycine max*) cultivars subjected to high- and low-input management levels on different sowing dates, in the southwestern region of the state of Paraná, Brazil. The experiment was carried out in the 2017/2018 and 2018/2019 crop seasons in the municipality of Itapejara D'Oeste. Five soybean cultivars (BMX Zeus IPRO, BMX Ativa RR, BMX Lança IPRO, NS 5445 IPRO, and NA 5909 RG) were evaluated in four environments formed by the combination of input management levels (high and low) and sowing dates (first and second). The experimental design was a randomized complete block with three replicates. The evaluated traits were: grain yield potential (kg ha^{-1}), in the R5 phenological stage; and grain yield (kg ha^{-1}) and its components, in the R8 stage. Cultivar, sowing date, and input management are determinant for maximizing grain yield potential. In the first sowing date, in October, the BMX Zeus IPRO cultivar shows a better response to the high level management, with a higher yield potential in the R5 stage (19,682 kg ha^{-1}) and a higher grain yield (8,248 kg ha^{-1}), whereas NA 5909 RG shows the best results with the low input management.

Index terms: *Glycine max*, grain yield, high performance management.

Potencial de rendimento de cultivares de soja modernas sob níveis alto e baixo de insumos

Resumo – O objetivo deste trabalho foi avaliar o potencial de rendimento de grãos de cultivares de soja (*Glycine max*) modernas submetidas a níveis alto e baixo de manejo de insumos, em diferentes datas de semeadura, na região Sudoeste do Paraná, Brasil. O experimento foi realizado nas safras de 2017/2018 e 2018/2019, no município de Itapejara D'Oeste. Cinco cultivares de soja (BMX Zeus IPRO, BMX Ativa RR, BMX Lança IPRO, NS 5445 IPRO e NA 5909 RG) foram avaliadas em quatro ambientes formados pela combinação de nível de manejo de insumos (alto e baixo) e datas de semeadura (primeira e segunda). O delineamento experimental foi de blocos ao acaso, com três repetições. As características avaliadas foram: potencial de rendimento de grãos (kg ha^{-1}), no estádio fenológico R5; e rendimento de grãos (kg ha^{-1}) e seus componentes, no estádio R8. A cultivar, a época de semeadura e o manejo dos insumos são determinantes para a maximização do potencial produtivo dos grãos. Na primeira data de semeadura, em outubro, a cultivar BMX Zeus IPRO apresenta melhor resposta ao manejo de alto nível, com maior potencial produtivo no estádio R5 (19.682 kg ha^{-1}) e maior produtividade de grãos (8.248 kg ha^{-1}), enquanto NA 5909 RG apresenta os melhores resultados com baixo manejo de insumos.

Termos para indexação: *Glycine max*, rendimento de grãos, manejo de alto desempenho.

Introduction

The growing international demand for commodities intensified during the Covid-19 pandemic, with price levels reaching new record highs (Borgards et al., 2021). The Food and Agricultural Organization (FAO, 2017) forecasts that there will be an increase of 2.3 billion people in the global population by 2050 and, consequently, an increase of 34% in the demand for food, which requires expanding considerably the agricultural area, as well as increasing yield per area.

Among the most important crops for world agribusiness, soybean [*Glycine max* (L.) Merrill] is considered an excellent protein – the main one in animal feed – and oil source (Anderson et al., 2019). Currently, Brazil is the world's leading soybean producer and exporter, followed by the United States and Argentina (USDA, 2022).

Worldwide, the average soybean grain yield per year is 2,880 kg ha^{-1}, with the highest average yield per country obtained in the United States (3,350 kg ha^{-1}), followed by Brazil (3,320 kg ha^{-1}) (USDA, 2022). Despite this high average, soybean still has a high yield potential that is yet to be explored. In competitive audits, the Brazilian yield record was 8,945 kg ha^{-1}, whereas the world record was 12,792 kg ha^{-1} in the United States (Iglesias, 2019; Cesb, 2020).

The expression of yield potential depends on the production environment, which must have an adequate nutrient availability, structured soil, high organic matter content, and water storage capacity (Mbuthia et al., 2015; Calonego et al., 2017). In addition to the production environment, other important factors are the choice of adapted and responsive cultivars (Felici et al., 2019), the right sowing date (Rattalino Edreira et al., 2017; Nóia Júnior & Sentelhas, 2020), available nutrients (Fontana et al., 2021), and pest management (Bandara et al., 2020; Roth et al., 2020).

According to the cultivar protection law of April 25, 1997 (Brasil, 1997), a large number of cultivars with a high productive potential were released in Brazil. Therefore, it is necessary to evaluate the grain yield potential of these recent cultivars, in order to define management strategies and investment levels that would result in economic profitability.

The objective of this work was to evaluate the grain yield potential of modern soybean cultivars subjected to high- and low-input management levels on different sowing dates, in the southwestern region of the state of Paraná, Brazil.

Materials and Methods

Field trials were conducted in the 2017/2018 and 2018/2019 crop seasons, on two sowing dates, in the municipality of Itapejara D'Oeste, in the state of Paraná, Brazil (25º97'S, 52º82'W, at an average altitude of 632 m). The average daily temperature during the soybean crop cycle was 22.5°C, and the accumulated precipitation was 1,154.6 and 1,196.4 mm for each crop season (Figure 1). The soil of the region is classified as a Latossolo Vermelho distrófico, according to the to the Brazilian soil classification system (Santos et al., 2018), corresponding to a Hapludox. The physicochemical soil analysis showed: 4.9 pH ($CaCl_2$), 28.05 g dm^{-3} organic matter (wet combustion), 7.21 mg dm^{-3} P (Mehlich-1), 0.08 $cmol_c$ dm^{-3} K, cation exchange capacity of 11 $cmol_c$ dm^{-3}, base saturation of 63.92%, 550 g kg^{-1} clay, 260 g kg^{-1} silt, and 190 g kg^{-1} sand. The experimental area has been cultivated under a no-tillage system for over 20 years.

Five soybean cultivars (BMX Zeus IPRO registered as 55I57RSF IPRO, BMX Ativa RR, BMX Lança IPRO registered as 58I60RSF IPRO, NS 5445 IPRO, and NA 5909 RG) were evaluated in four different environments (E1 to E4), formed by combinations of the first or second sowing date with high or low input management. The environments were: E1, high input and first sowing date on October 10; E2, low input and first sowing date on October 10; E3, high input and second sowing date on November 10; and E4, low input and second sowing date on November 10. The experimental design was a randomized complete block with three replicates. Each plot consisted of four lines of soybean (5.0 m long and spaced at 0.45 m), and planting density was adjusted according to the recommendations for each cultivar.

In the high input management treatment, millet [*Pennisetum americanum* (L.) Leeke] was cultivated in the experimental area before the soybean crop during summer, and black oat (*Avena strigosa* Schreb.) was planted immediately after in winter. Soybean was seeded manually, and a drip irrigation system was used for each line, spaced at 0.2 m. Ten tensiometers were installed at specific points to monitor soil water potential, aiming to keep soil moisture close to field capacity. All crops were cultivated using a mineral fertilizer to facilitate high yields. Base fertilization consisted of 350 kg ha^{-1} mineral fertilizer, containing 7.0% nitrogen, 36% phosphorus oxide, 10% potassium oxide, 1.2% calcium, 7.0% sulfur, 0.08% boron, 0.08% copper, 0.16% manganese, and 0.16% zinc. In addition, a topdressing fertilization with 250 kg ha^{-1} KCl was applied in the V4 phenological stage. In the low input treatment, the area was kept fallow in autumn, followed by the cultivation of black oat without fertilization, as usually practiced in the region. Soybean was also seeded manually, but no irrigation system was used. Base fertilization consisted of 350 kg ha^{-1} mineral fertilizer, containing 2.0% N, 20% P_2O_5, and 20% K_2O. The agricultural production inputs that were used in the high- and low-input management levels are described in Table 1.

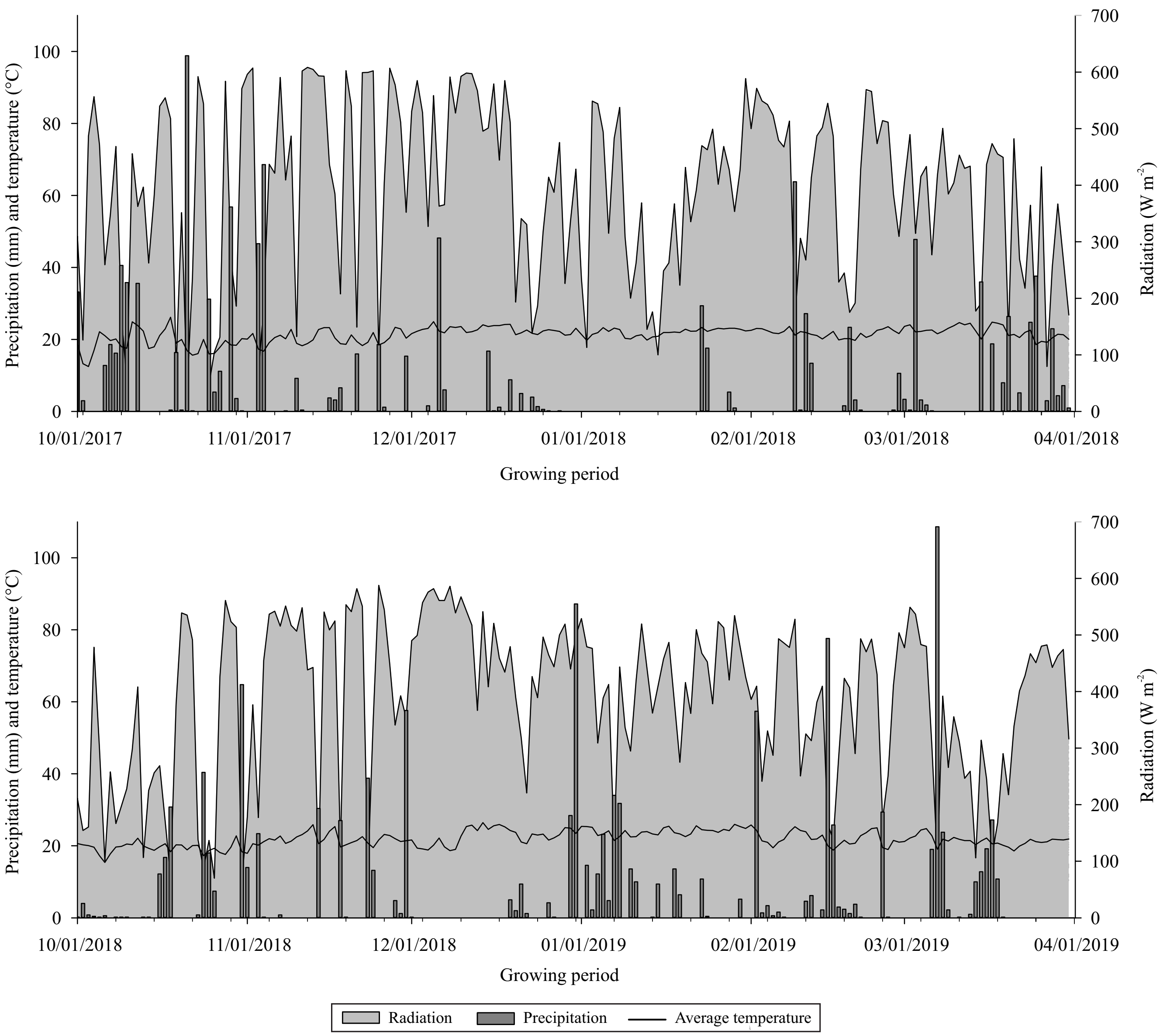

Figure 1. Meteorological data for daily average temperature, daily precipitation, and solar radiation in the 2017/2018 and 2018/2019 soybean (*Glycine max*) crop seasons, in the municipality of Itapejara D'Oeste, in the state of Paraná, Brazil. Source: Simepar (2022), Code ANA: 2652042.

DOI: 10.1590/S1678-3921.pab2022.v57.02852

Grain yield potential (kg ha^{-1}) was estimated according to methodology adapted from Maehler et al. (2003) and Rambo et al. (2004). In each plot, five plants were identified and the number of reproductive structures in the R5 stage was counted (Fehr & Caviness, 1977). At the R8 maturity stage, these plants were harvested and evaluated for number of grains per pod (NGP) and weight of a thousand grains (TGW, g). From the obtained data, grain yield potential (YP) was estimated using the following equation: YP = (NER × NGP × TGW × NP / 1000), where NER is the number of reproductive structures (flowers and pods) quantified at R5, NGP is the average number of grains per pod measured at R8, TGW is the weight of a thousand grains quantified at R8, and NP is the final stand of plants per hectare.

To determine grain yield (kg ha^{-1}), the two central lines of each plot were harvested manually. After the plants were threshed, grain weight was converted to kg ha^{-1} and expressed at a moisture content of 13%. The TGW was obtained by multiplying the weight of eight replicates of 100 seeds per plot by a factor of ten (Brasil, 2009). The following measurements were

Table 1. Description of high- and low-input level managements for five soybean (*Glycine max*) cultivars – BMX Zeus IPRO, BMX Ativa RR, BMX Lança IPRO, NS 5445 IPRO, and NA 5909 RG – evaluated during the 2017/2018 and 2018/2019 crop seasons in the municipality of Itapejara D'Oeste, in the state of Paraná, Brazil.

Input	Active ingredient	Rate (g a.i. ha^{-1})	Phenological stage of application	Input management	
				High	Low
Seed treatment	Piraclostrobin + Methyl thiophanate + Fipronil	5+45+50	TS	X	
	Bradyrhizobium japonicum	$5x10^7$			
	Azospirillum brasiliense	$2x10^6$			
	Trichoderma harzianum	$3.6x10^7$			
	Co + Mo	1 + 10			
Weed control 1	Potassium glyphosate	620	V_2	X	X
Weed control 2	Potassium glyphosate	620	V_5	X	
	Carbendazim	500			
	P_2O_5+Mo	30+30			
Disease and pest control 1	Thiophanate-methyl + Fluazinam	375+375	R_1	X	
	Carbendazim	500			
	Teflubenzuron	23			
Disease and pest control 2(1)	Epoxiconazole + Fluxapyroxad + Pyrclostrobin	50+50+81	R_1+15	X	X
	Mancozeb	1.500			
	Teflubenzuron	23			
Disease and pest control 3	Picoxystrobin + Benzovindiflupyr	60+30	R_1+30	X	
	mancozeb	1.500			
	Thiamethoxam + Lambda-cyhalothrin	28+21			
	Teflubenzuron	23			
Disease and pest control 4(1)	Trifloxystrobin + Prothioconazole	60+70	R_1+45	X	X
	mancozeb	1.500			
	Acetamiprid + Bifenthrin	50+50			
	Chlorantraniliprole	10			
Disease and pest control 5(1)	Trifloxystrobin + Protioconazol	60+70	R_1+60	X	X
	Mancozeb	1.500			
	Chlorantraniliprole	10			
Disease and pest control 6(2)	Trifloxystrobin + Cyproconazole	75+32	R_1+75	X	
	Fenpropimorph	250			
	Chlorantraniliprole	10			

(1)For the low input management, mancozeb was not applied. (2)The sixth application was performed only on cultivars BMX Lança IPRO and NA 5909 RG.

taken for the five plants identified in each plot: plant height (cm); and number of pods per plant (NPP), calculated by multiplying the NGP by NPP.

Data were subjected to the analysis of homogeneity of variance and normality of residuals using the Bartlett and Lilliefors tests, respectively. A joint analysis of variance was performed in a factorial arrangement, taking into account environment × cultivar factors in each crop season. Tukey's test was used to verify if the means differed significantly at 5% probability. Statistical analyses were carried out using the ExpDes.pt package (Ferreira al., 2018) in the R software (R Development Core Team, 2019).

Results and Discussion

The analysis of variance showed a significant cultivar × environment interaction for yield potential and plant height in the 2017/2018 crop season, as well as for grain yield, TGW, and plant height in 2018/2019 (Table 2). However, in both crop seasons, all evaluated traits were significantly affected by cultivar and environment. Furthermore, in 2017/2018, E1 resulted in the highest grain yield, with an average of 7,141 kg ha^{-1}, whereas, in 2018/2019, E1, E2, and E3 showed grain yields higher than the average (Table 3).

Yield potential did not differ significantly between environments for cultivars BMX Ativa RR and BMX Lança IPRO in the 2017/2018 crop season (Table 3). In both crop seasons, however, a lower mean yield potential was observed in the second sowing date, i.e., in E3 and E4, both with a mean of 7,087 kg ha^{-1}, compared with the first sowing date, that is, with E1 and E2, with means of 15,471 and 14,524 kg ha^{-1}, respectively. Sowing date is an important factor for the success of a crop due to the differences in water relations, as well as in temperature, photoperiod, and solar radiation availability (Zanon et al., 2015; Nóia Júnior & Sentelhas, 2020). In the western region of the state of Santa Catarina, Brazil, Meotti et al. (2012) also observed that later sowing dates negatively affected the performance of adaptive characters and the grain yield of the evaluated cultivars. Therefore, sowing at an ideal time can be an effective way to reach a grain yield near the maximum yield potential of soybean.

Cultivar BMX Zeus IPRO showed a higher yield potential in E1 in the first crop season and a high mean grain yield in the same environment in 2017/2018 and 2018/2019 (Table 3), with an increase of 9.5%, on average, in grain yield in the high input management. Cultivar BMX Ativa RR showed a similar average grain yield and yield potential in both crop seasons. The NA 5909 RG cultivar showed good performance as to yield potential in E2 in the 2017/2018 and 2018/2019 crop seasons. Moreover, among the studied cultivars, there was an increase in the conversion rate of yield potential to grain yield of ~62 and ~72% in each crop

Table 2. Summary of the analysis of variance for agronomic traits of five soybean (*Glycine max*) cultivars grown under different environments (combination of first or second sowing dates and high or low input levels) during the 2017/2018 and 2018/2019 crop seasons, in the municipality of Itapejara D'Oeste, in the state of Paraná, Brazil.

Crop season	Source of variation	Block	Cultivar (C)	Environment (E)	C x E	Residual	Mean	CV (%)
	Degrees of freedom	2	4	3	1	38		
	Trait[1]	Mean square						
2017/2018	Grain yield potencial	28.22^{ns}	194.25*	2,919.68**	224.97**	60.7	11.902	36.43
	Grain yield	2,006,995**	2,299,674**	8,967,250**	339,216^{ns}	275,620	6.148	15.65
	TGW	340.1^{ns}	2,552.5**	827.2**	56.1^{ns}	76.7	192	8.74
	NPP	3.0^{ns}	1,684.1**	1,572.6**	147.3^{ns}	80.7	64.0	29.36
	Plant height	61.80^{ns}	2,491.1**	1,626.9**	90.888*	38.67	105.9	16.28
2018/2019	Grain yield potencial	714,987^{ns}	9,188,394*	111,537,827**	11,265,860**	2,577,502	9.443	33.94
	Grain yield	8,057^{ns}	1,574,897*	1,255,727*	1,077,280**	589,309	5.434	16.77
	TGW	8.6^{ns}	1,179.1**	520**	188.7**	23.90	183	7.01
	NPP	12.6^{ns}	707.94**	3,761.3**	125.74^{ns}	178.89	74.5	16.2
	Plant height	175.6^{ns}	1,377.4**	692.7**	110.7*	39.7	82.6	16.3

[1]TGW, weight of a thousand grains; NPP, number of pods per plant; and CV, coefficient of variation. ** and *Significant by the F-test, at 1 and 5%, respectively. ^{ns}Nonsignificant.

season. Therefore, when yield potential and grain yield are related, the mean conversion rate is 47% in both crop seasons.

The highest yield potential was obtained with the high-level input management in E1 (Table 3). Grain yield increased in 9.5% from the low (E2 and E4) to the high (E1 and E3) input management, which showed a mean grain yield of 5,567 and 6,096 kg ha^{-1}, respectively. However, the response of the crops to the different technological levels of management depends on the growing region. Orlowski et al. (2016), for example, when using high input management, observed that, from the Southern to the Northern region of the United States, there was an increase of 12% in yield.

In the 2017/2018 crop season, plant height was higher in the first sowing date (E1 and E2) for all cultivars (Table 4). This could be explained by the fact that the second sowing date (E3 and E4) occurred

Table 3. Grain yield potential and grain yield of five soybean (*Glycine max*) cultivars evaluated in four environments in the 2017/2018 and 2018/2019 crop seasons, in the municipality of Itapejara D'Oeste, in the state of Paraná, Brazil[(1)].

Crop season	Cultivar	Environment[(2)]				Mean
		E1	E2	E3	E4	
		Grain yield potential (kg ha^{-1})				
2017/2018	BMX Ativa RR	12,623Ab	12,126Aa	8,532Aa	8,580Aa	10,465c
	BMX Lança IPRO	12,817Ab	12,724Aa	8,443Aa	9,602Aa	10,896c
	BMX Zeus IPRO	19,682Aa	14,717Ba	9,333Ca	8,396Ca	13,032a
	NA 5909 RG	15,405ABab	16,992Aa	8,529Ca	11,370BCa	13,074a
	NS 5445 IPRO	16,830Aab	16,020Aa	7,303Ba	8,009Ba	12,040b
	Mean	15,471A	14,524A	8,428B	9,191B	11,901
2018/2019	BMX Ativa RR	11,085Ab	9,412ABb	7,246BCa	6,244Ca	8,497
	BMX Lança IPRO	10,162ABb	11,303Ab	8,292BCa	7,061Ca	9,205
	BMX Zeus IPRO	12,764Aab	10,447ABb	7,972Ba	7,789Ba	9,743
	NA 5909 RG	11,803Bab	17,344Aa	6,723Ca	7,253Ca	10,788
	NS 5445 IPRO	14,033Aa	9,602Bb	6,014Ca	6,278Ca	8,982
	Mean	11,975 A	11,622 A	7,249 B	6,925 B	9,443
		Grain yield (kg ha^{-1})				
2017/2018	BMX Ativa RR	7,109[ns]	6,376	6,138	5,904	6,382ab
	BMX Lança IPRO	6,958	6,299	5,876	5,103	6,059bc
	BMX Zeus IPRO	8,248	6,931	6,105	5,643	6,731a
	NA 5909 RG	6,949	6,679	5,369	5,037	6,009bc
	NS 5445 IPRO	6,441	5,465	5,304	5,035	5,561c
	Mean	7,141A	6,350B	5,759C	5,344C	6,148
2018/2019	BMX Ativa RR	6,188Aab	5,149Aa	5,622Aa	6,185Aa	5,786ab
	BMX Lança IPRO	5,058Bab	5,691ABa	6,597Aa	5,099Bab	5,611ab
	BMX Zeus IPRO	6,533Aa	5,267Aa	6,037Aa	5,918Aa	5,939a
	NA 5909 RG	4,904Ab	5,946Aa	5,303Aa	4,668Aab	5,205ab
	NS 5445 IPRO	5,834Aab	4,787ABa	5,348ABa	4,158Bb	5,032b
	Mean	5,703A	5,368A	5,781A	5,206B	5,515

[(1)]Means followed by equal letters, lowercase in the columns and uppercase in the rows, do not differ according to Tukey's test, at 5% probability. [(2)]E1, high input and first sowing date on October 10; E2, low input and first sowing date on October 10; E3, high input and second sowing date on November 10; and E4, low input and second sowing date on November 10. [ns]Nonsignificant effect between cultivar and environment.

when days were shorter, a period when photoperiod-sensitive soybean cultivars show reduced height, early flowering, and reduced yield (Han et al., 2006). In this crop season, the highest plant heights were obtained for: cultivar NA 5909 RG in E1 and E4; cultivars NA 5909 RG, NS5445 IPRO, and BMX Lança IPRO in E2; and cultivars NA 5909 RG and BMX Lança IPRO in E3. In the 2018/2019 crop season, plant height was higher in E1 and E3, both with a high input management, compared with E2, with a low input management.

In the 2017/2018 crop season, a greater TGW was observed for cultivars NS 5445 IPRO and BMX Zeus IPRO (Table 5). In 2018/2019, the values obtained were greater for cultivar BMX Zeus IPRO in E1 and E3 (Table 4) and lower for NA 5909 RG in E1 and E3 (high input) and for BMX Lança IPRO in E2 and E4 (low input). According to Orlowski et al. (2016), high input management usually promotes the greatest TGW, as observed in the present study.

Cultivar NA 5909 RG had the highest NPP, followed by BMX Lança IPRO, in the 2017/2018 crop season (Table 5). However, the NA 5909 RG and BMX Lança IPRO cultivars showed the highest NPP, followed by BMX Zeus IPRO, in 2018/2019. Regarding environments, E1 and E2 (first sowing date) showed higher NPP in both crop seasons. These results agree with those of Zanon et al. (2015), who found more pods in plants planted at an earlier sowing date, which is considered better for soybean development due to photoperiod and temperature effects.

The results obtained in the present study and in the literature (Orlowski et al., 2016; Santos et al., 2021) are indicative that high-input crop management – with an increased application of fertilizers and chemicals – has positive effects on grain yield; however, it may compromise economic sustainability, which was not assessed here. In this context, high input systems must be implemented in stages, starting by improving soil

Table 4. Plant height and weight of a thousand grains (TGW) of five soybean (*Glycine max*) cultivars evaluated in four environments in the 2017/2018 and 2018/2019 crop seasons, in the municipality of Itapejara D'Oeste, in the state of Paraná, Brazil[1].

Crop season	Cultivar	Environment[2]				Mean
		E1	E2	E3	E4	
		Plant height (cm)				
2017/2018	BMX Ativa RR	91.7Abc	97.6Ac	93.0Bb	82.3Bc	91.1c
	BMX Lança IPRO	114.7ABb	121.1Aab	107.7Ba	106.9Bb	112.6ab
	BMX Zeus IPRO	112.9Ab	111.7Ab	97.9Bab	97.1Bb	104.5b
	NA 5909 RG	139.3Aa	125.7Ba	108.1Ca	118.9Ba	123.0a
	NS 5445 IPRO	115.3Ab	115.7Aab	91.2Bb	99.5Bb	105.4b
	Mean	114.8A	114.4A	99.6B	100.9B	107.4
2018/2019	BMX Ativa RR	65.2ABc	55.1Bc	72.1Ab	62.6ABc	63.7c
	BMX Lança IPRO	95.7Aab	84.4Aa	88.1Aa	86.2Ab	88.6b
	BMX Zeus IPRO	90.0Ab	71.5Bb	91.5Aa	90.9Aab	86.0b
	NA 5909 RG	106.9Aa	84.9BCa	91.6ABa	91.1Ba	93.6a
	NS 5445 IPRO	91.5Ab	76.1Bab	87.4Aa	84.5ABab	84.9b
	Mean	89.9A	74.4B	86.1A	83.1AB	83.4
		Weight of a thousand grains (TGW, g)				
2018/2019	BMX Ativa RR	190Ab	187Aa	177Bc	170Bdc	181b
	BMX Lança IPRO	177Ac	177Ab	183Abc	163Bd	175c
	BMX Zeus IPRO	203Ba	190Ca	217Aa	193Ca	201a
	NA 5909 RG	170Bc	183Aab	177Abc	173Bc	176c
	NS 5445 IPRO	190Ab	177Bb	190Ab	183ABb	185b
	Mean	186A	183AB	189A	176B	184

[1]Means followed by equal letters, lowercase in the columns and uppercase in the rows, do not differ according to Tukey's test, at 5% probability. [2]E1, high input and first sowing date on October 10; E2, low input and first sowing date on October 10; E3, high input and second sowing date on November 10; and E4, low input and second sowing date on November 10.

physicochemical characteristics and analyzing annually if it is necessary to invest in specific applications (Quinn & Steinke, 2019). Greer et al. (2020) evaluated the impact of input level on sustainability and economy during three years in the United States and found that, in two seasons, the high input level showed results superior to those of the low- and standard-input managements. In their economic analysis, the authors observed a greater return when associating the high input level with high commodity prices. Therefore, before using a high input management, environmental and economic sustainability should be considered.

In the present study, the expression of maximum potential yield depended on the interaction between genetic, environmental, and crop management factors. A high input environment maximizes grain yield and increases the conversion rate of potential yield to grain yield. Therefore, choosing an adequate sowing date and prioritizing the period of greatest radiation and temperature are important for obtaining a better result. To reduce losses in soybean potential yield, in future studies, there is also a need to improve management factors such as plant architecture, soil fertility, seed quality, plant standard, disease control, and insect resistance, among others.

Table 5. Mean number of pods per plant (NPP) and weight of a thousand grains (TGW) of five soybean (*Glycine max*) cultivars evaluated in four environments in the 2017/2018 and 2018/2019 crop seasons, in the municipality of Itapejara D'Oeste, in the state of Paraná, Brazil.

Cultivar	TGW (g)	NPP	
	2017/2018	2017/2018	2018/2019
BMX Ativa RR	186b	50.4d	75.4ab
BMX Lança IPRO	178b	72.8ab	79.5a
BMX Zeus IPRO	207a	62.3bc	70.5ab
NA 5909 RG	182b	80.3a	83.3a
NS 5445 IPRO	209a	54.2cd	63.7b
Environment			
E1	198a	70.9a	90.6a
E2	185b	75.9a	85.4a
E3	199a	50.2c	63.4b
E4	188b	58.4b	58.7b

[(1)]Means followed by equal letters, in the columns, do not differ by Tukey's test, at 5% probability. E1, high input and first sowing date on October 10; E2, low input and first sowing date on October 10; E3, high input and second sowing date on November 10; and E4, low input and second sowing date on November 10. [ns]Nonsignificant effect between cultivar and environment, as shown in Table 2.

Conclusions

1. Cultivar, sowing date, and input management are determinant for maximizing soybean (*Glycine max*) grain yield potential.
2. In the first sowing date, in October, cultivar BMX Zeus IPRO shows the best response, as well as a greater yield potential and grain yield in the high input management, whereas NA 5909 RG presents the best performance in the low input management.

Acknowledgments

To Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (Capes), for financial support (Finance Code 001).

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