Ecological Consequences of Increasing Crop Productivity

Plant Breeding and Biotic Diversity

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CHAPTER 18

THE QUALITY OF SUGAR BEET SEEDS AND THE WAYS OF ITS INCREASE

VOLODYMYR AR. DORONIN, YAROSLAV V. BYELYK, VALENTIN V. POLISHCHUK, and LESYA M. KARPUK

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18.1 INTRODUCTION

To ensure the competitiveness of the sugar beet in the global market, it is necessary to create the conditions to ensure high technological level of growth, which meets the requirements of sustainable development, to implement high environmental standards for the sugar beet processing and to orient the consumers to their market. Many factors determine sugar beet productivity in the intensive agriculture: soil and climatic conditions, the implementation of high-productivity hybrids, the qualitative preseeding processing of seeds, the use of modern techniques and technologies, fertilizers, reliable plant protection, high-tech improvements on the factories, etc. All these factors can reduce the sugar beet productivity significantly, but it is not possible to achieve the maximum yield of culture without the use of high-quality seeds of new hybrids.

The quality of sugar beet seeds is determined by the complex of genetic factors that are controlled by plant breeders and agroecological and agrotechnical conditions of their growing and methods of post-harvest and preseeding seed preparation with modern technology use [1]. Therefore, we have focused only on those methods influencing directly the yield and quality of sugar beet under its cultivation with and without plantings methods and in the process of its preseeding preparation. The most important indicators of seed quality are its viability, germination energy, field germination, one sprouting, uniformity, and stability in the size and forms.

Among the many factors influencing the growth, development, and yield formation and quality of seeds of great importance are the processes of controlled regulation of flowering and pollination of seed plants, especially under growing hybrids of seeds based on cytoplasmic male sterility (CMS). It is next to impossible to avoid the formation of a large number of small seeds that under the current standard [2] do not refer to the seeds and is lost by the post-harvest purification of heap without solving the problem of the methods improvement of the directional regulation of growth processes. Also, these methods aim at limiting the growth of tall plants, which improves the conditions of seed harvesting, reduces the losses, and increases the yield and quality.

To limit growth of sugar beet seed plants, they use manual, mechanical, and chemical minting. This method provides more productive seed plants through central stem growth limiting, which results in the more active entry of side stems nutrients, which improves their growth and development and, ultimately, increases their productivity [3].

With the removal of an apical meristem of the central stem, its growth and development is suspended. But not only the point of growth under the minting is removed, some part of the stem with fruit on it is removed as well; as a result, redistribution of nutrients and other substances necessary for the growth of both central and side stems takes place. Instead of entering the point of growth for central stem growth, development, and new small fruits formation, these substances enter the fruit remaining on the stems of seed plants. Application of minting forms larger seeds, and it accumulates more nutrients as well. Application of this agriculture method in the early phase of stem formation accelerates the start of seed plants flowering within 2 3 days. This method is easier and ends at earlier term, which in turn accelerates the maturation of seeds within 2 3 days. Also, a positive effect of the minting on the seed quality, especially when the minting is done in the late phase of stem formation, is observed [4].

According to V Faydyuk, the yield of Ukrains kyi ChS 70 hybrid seed is increased by 0.09 t/ha, similar to 3 percent under applying seed plants minting [5]. Odessa region, by both manual and mechanized minting in the early phase of stem formation, has shown an increase in the yield of seed by 0.15 0.35 t/ha, compared to the control without minting under planting way of seed growing [6]. In irrigated conditions of Crimea at Zarichniy farm on an area of 1.1 ha, the minting in the phase of mass stem formation has provided the increase of the seed yield of varieties of populations by 0.57 t/ha, and similarly by 3 percent [7]. Thus, the previous researches conducted on growing ordinary seeds of the varieties-populations and sugar beet hybrids based on CMS both with plantings and without plantings ways demonstrate the high efficiency of minting as the method of directed regulation of seed plants growth and development and their flowering, pollination, and fertilization. The modern hybrids of sugar beet have high potential of seed productivity, but for its more complete implementation they should create favorable conditions for the growth of mating components. Therefore, studying the growth process of mating components and development regulation, synchronization of its flowering and formation of base seed yield by the criterion of maximum seed productivity was topical.

One of the most perspective ways of improving the seed quality is its pre-sowing preparation in the seed plants, which includes seed cleaning from impurities that do not relate to the main crop seeds, sizing, polishing, sorting by the aerodynamic properties and specific gravity, stimulation, pelleting, and encrusting. The stimulation of the intensity of seed germination is possible with the use of mechanical methods of seed preparation on the seed plants by way of removing the artificial barriers to seed germination, the use of growth stimulants, and microelements. However, the most perspective way to increase the intensity is to initiate the passing of germination start phase with its follow suspension, which was the goal of our research.

18.2 MATERIALS AND METHODODOLOGY

The research program envisaged studying the specifics of seed quality formation both under seeds growing and its pre-sowing preparation in the seed plants. The research was conducted at the Institute of Bioenergy Crops and Sugar beet of NAAS, Uman Experimental Breeding Station, Uman National University of Horticulture, and Vinnytsa seed factory Ahrohrad V Ltd in 2008 2013.

The field experiments were conducted according to the following scheme:

1. No minting control;
2. 50 percent minting of plant pollinator;
3. 50 percent minting of plant pollinator and 100 percent of plant CMS component.

The study of the optimal terms of minting and its efficiency in the processes of flower formation, the flowering synchrony, and seed plant productivity was performed simultaneously on the paternal and maternal components Umans kyi ChS 97 sugar beet triploid hybrids. The minting was carried out manually in the period of mass stem formation when the plants were 60 70 cm in height. At the same time, we removed the top of the main stem for 5 10 cm. The area of scoring plot was 56 m^2, with triple repetition.

To stimulate the seed under the production conditions, 12 parties of calibrated seed of diploid hybrids Ukrains kyi ChS 72, Vesto and triploid Dobroslava, Oleksandriia were used. The stimulation of seed was performed by the method of Institute of Bio-energy Crops and Sugar Beets. Nonstimulated seed was sown in the control variant.

We determined in the laboratory conditions germination energy, field germination, and seeds purity [8], the mass of 1,000 fruits and one sprouting and one seeding [9]. The selection of the average seed samples was performed in accordance with applicable State standards of Ukraine (DSTU) [10]. The number of flowers by he experiment variants was determined by calculation; the seeds yield was determined by weighing the heap from the calculation plot and from the individual seed plants in the field conditions on the seed plants. The statistical processing of the experimental data was carried out by the methods of R.A. Fisher [11] with the appropriate computer software.

18.3 RESULTS AND DISCUSSIONS

The research has proved that the minting of seed plant-mating components has a positive effect on the processes of growth and development and on the flowering synchronicity and flower formation in particular. The suspension of the stem tops growth results in redistribution of nutrients, improves the supply of flowers formed, which contributes to additional formation of high-quality seeds and thus an increase in its productivity.

The experiments are conducted with the plants of CMS component and Umans kyi ChS 97 triploid hybrid O-type in tunnel isolation (Figure 18.1).

FIGURE 18.1 The flowering of basic components in the tunnel isolation (after the minting in the depths of picture and without it in the foreground).

Minting is free (control) in the variant; the variability of the number of flowers, during the flowering, by the date of accounting was in the CMS component from 58.5 to 806.7 pc./plant in the sterility fixator (O-type) from 124.5 to 939.9 pc./plant (Figure 18.2(a)).

During all the dates of account of O-type, there were more flowers than in the MS component, which indicates no synchronicity of flowering of mating components, and which ultimately affects negatively the degree of tying seeds, its germination, and seed production.

The minting of 50 percent of the plants of O-type somewhat reduced the intensity of its flower formation during the whole period of flowering, compared to the control (Figure 18.2(b)). Thus, at the beginning of flowering 124.5 flowers/plants were formed without minting and 98.4 with minting. Similar results were obtained in the last date of accounting.

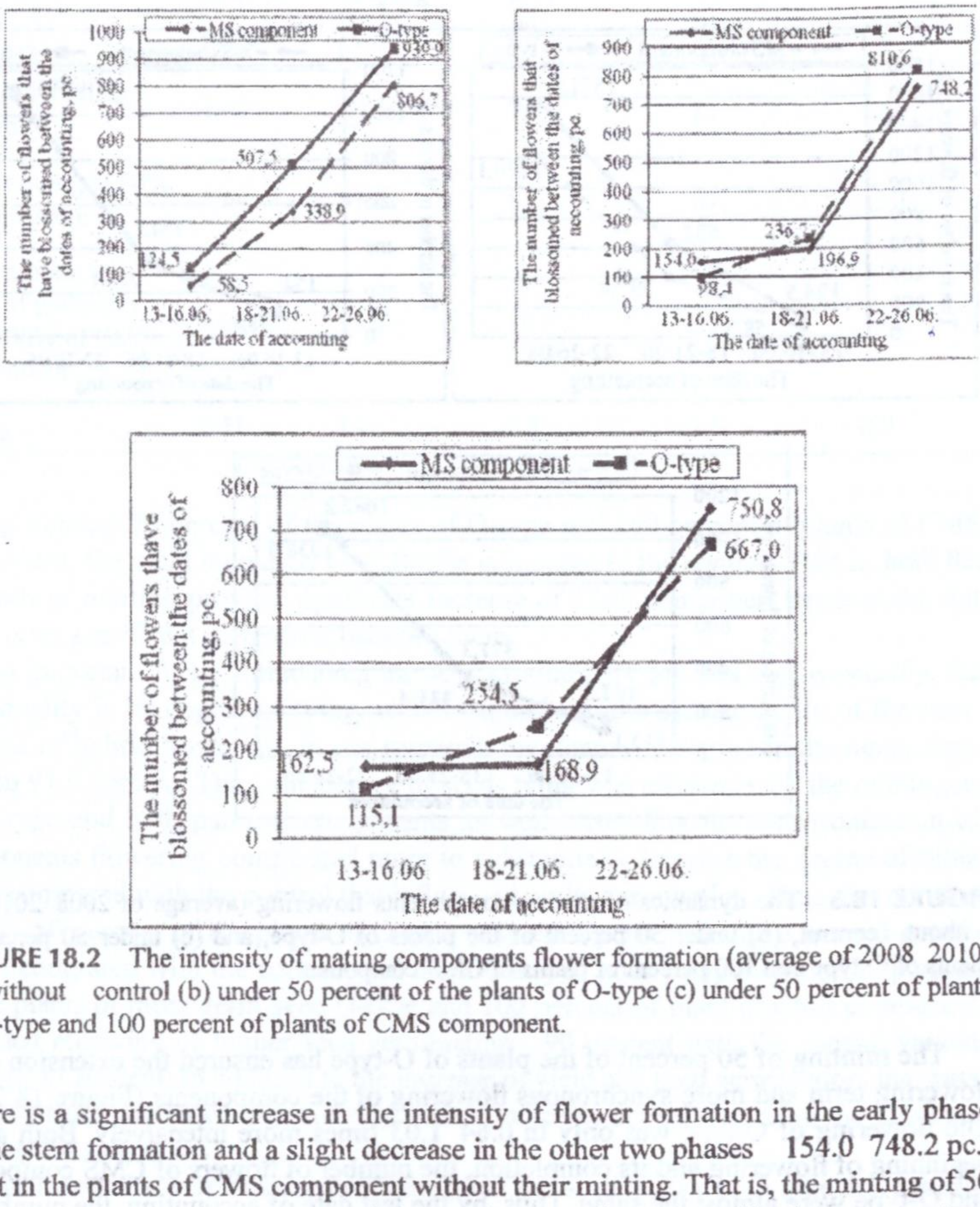

FIGURE 18.2 The intensity of mating components flower formation (average of 2008 2010) (a) without control (b) under 50 percent of the plants of O-type (c) under 50 percent of plants of O-type and 100 percent of plants of CMS component.

There is a significant increase in the intensity of flower formation in the early phase of the stem formation and a slight decrease in the other two phases 154.0 748.2 pc./plant in the plants of CMS component without their minting. That is, the minting of 50 percent of plants of O-type ensured the synchronous flowering of both components at the beginning of flowering, and at its end.

In the variant of 50 percent of the plants of O-type minting and 100 percent plants of its sterile analogue (MS component), there was a negligible deviation of variation of the number of flowers of the two components that makes 115.1 667.0 pc./plant for a O-type and 162.5 750.8 pc./plant for the CMS component (Figure 18.2(c)).

Thus, minting of both plants of the O-type and of both components of breeding has provided the synchrony of flower formation and their flowering. Without the minting, the flowering of seed plants of O-type began and was finished in 2.1 times earlier, and it took place more intensively at the beginning of flowering and 1.3 times at the end of flowering, than that of the CMS component seed plants, that is, the flowering of mating components was not synchronous (Figure 18.3(a)).

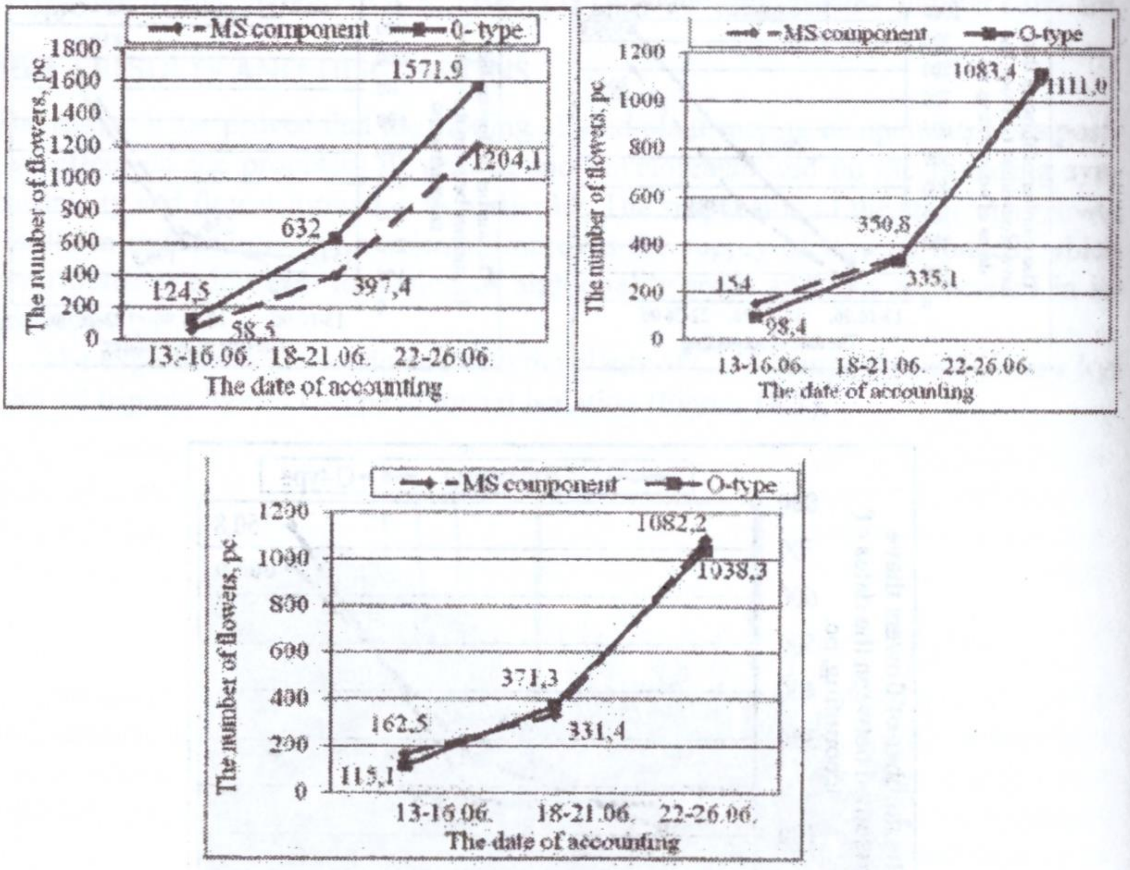

FIGURE 18.3 The dynamics of mating components flowering (average of 2008 2010) (a) without control, (b) under 50 percent of the plants of O-type, and (c) under 50 percent of plants of O-type and 100 percent of plants of CMS component.

The minting of 50 percent of the plants of O-type has ensured the extension of its flowering term and more synchronous flowering of the components (Figure 18.3(b)). The flowering of O-type was only in 0.64 1.03 times more intensively. Both at the beginning of flowering and its completion, the number of flowers of CMS component and O-type were almost the same. Thus, by the last date of accounting, the number of flowers that bloomed in the CMS component were 1082.2 pc/plant, in O-type 1038.3 pc./plant.

It was established in the process of studying the influence of plant minting of diploid CMS component on seed production that this method contributes to a significant increase in the yield of the baseline seed (Table 18.1).

TABLE 18.1 The yield of baseline seed of CMS component increased to 0.17 t/ha under minting 50% of the plants of O-type.

Variant	Yield of seed (t/ha)	The degree of tying (%)	Energy of germination (%)	Field germination (%)	Mass of 1,000 pc (g)
Without minting control	1.47	86.6	76	81	12.0
The minting of 50% of pollinator	1.64	91.0	85	87	13.1
The minting of 50% of pollinator and 100% of CMS component	1.67	91.0	87	90	13.1*
LSD_{05}	0.11	1.4	3.3	3.5	0.7

By minting 50 percent of the plants of O-type and 100 percent of plants of CMS component, the yield increased by 0.20 t/ha compared to the control. That is, both the methods of minting provide significant increase of CMS component seeds yield, but there is no significant difference between them.

An important factor influencing the seed productivity indexes and, especially, the seed quality is its degree of tying, which depends on the synchronicity of the components of hybrid flowering. In our research, this feature is varied in the range from 86.6 to 91.0 percent. Thus, the degree of seeds tying was affected with the minting as an O-type and both parental components as well. Providing the synchronization of components flowering contributed more to substantially increase the degree of tying seeds compared with the control that influenced on its germination. Thus, the minting of only 50 percent of the plants of O-type ensured 6 percent increase in seed germination compared with the control, and the minting of both components of 50 percent of the plants of monogerm seed O-type and 100 percent of plant of CMS component provided receiving of higher seed germination 90 percent with the control variant index of 81 percent. In addition to the increase of yield and seed germination, the mass of 1,000 fruits increased significantly, which indicates actively entering the nutrients forming the side stems.

Similar results were obtained with the yield and seed quality of O-type that depend on the directional regulation of flowering process of the hybrid components. The yield of seed increased to 0.17 0.20 t/ha and seed germination increased from 82 percent (control) to 87 90 percent (in variants with minting). The highest index of germination is observed in the variant, where the minting was applied on 50 percent of plants and 100 percent of plants of CMS component (Table 18.2).

TABLE 18.2 The yield and quality of O-type basic seed depending on the directional regulation of the process of flowering depending on seed plant minting (average of 2008 2010)

Variant	Yield of seed (t/ha)	The degree of tying (%)	Energy of germination (%)	Germination (%)	Weight of 1,000 pc (g)
Without minting control	1.48	88.8	78	82	12.2
The minting of 50% of pollinator	1.65	93.4	85	87	13.3
The minting of 50% of pollinator and 100% of CMS component	1.68	93.7	87	90	13.5
LSD_{05}	0.04	1.7	2.6	3.1	0.4

The increase of seed germination is caused by better pollination of O-type plants, as evidenced by the degree of seed tying, which increased by 4.6 4.9 percent compared with the control. The minting positively impacts on the mass of 1,000 seeds of CMS component and O-type. The significant increase of the mass of 1,000 fruits in variants with directional regulation of the process of flowering is caused by better redistribution of nutrients.

The restriction of the central stem growth results in the more active nutrients entering the side stems, where the basic mass of the seeds is formed, improving their growth and development and, ultimately, decreasing the number of fruits of the diameter less than 3.50 mm, which does not relate to the seeds and is lost in the post-harvest treatment of heap. It is found out that under regulation of the process of flowering the number of fruit with the 3.00 3.50 mm diameter fraction decreased by 1.7 2.0 times of CMS component and by 1.9 2.2 times of O-type and the yield of sown fraction of seeds increased accordingly by 8 10.4 and 9.7 11 percent (Table 18.3). Thus, without minting the number of seeds 3.00 3.50 mm fraction of CMS component was 24.3 percent, while both under minting only of 50 percent of the plants, it was 14.3 percent, and under minting of 50 percent of plants of O-type and 100 percent of plants of CMS component was 12.3 percent.

TABLE 18.3 The influence of regulation of the flowering and fertilization process on the fractional structure of seeds depending on seed plant minting (average for 2008 2010)

Variant	The content of fractions of seed (mm, %)			
	> 5.50	4.50 5.50	3.50 4.50	3.00 3.50
CMS component				
Without minting control	3.7	14.7	57.3	24.3
The minting of 50% of pollinator	5.7	17.7	62.3	14.3
The minting of 50% of pollinator and 100% of CMS component	5.3	18.7	63.7	12.3
O-type				
Without minting control	4.3	12.3	60.7	22.7
The minting of 50% of pollinator	5.7	16.7	66.0	11.7
The minting of 50% of pollinator and 100% of CMS component	5.7	16.7	67.3	10.3

By minting both components, we obtained the highest yield of sown seed fractions 82.4 percent. Under minting of 50 percent of the O-type, we observed somewhat lower yield of sown seeds fraction compared with the minting of both components due to a high content of fine fraction less than 3.50 mm. Similar results were obtained with the O-type.

Thus, the directed regulation of processes of flowering and flower formation of seed plant mating components has a positive effect on the processes of growth and development, particularly on the synchronicity of flower formation, flowering, and seed tying degree and consequently on its yield and quality. The yield of seed and its quality increased significantly compared with the control (without minting) as a CMS component and O-type. Along with the yield increase, the yield of seeds sown fractions increases due to reduction of fruits, with a diameter of less than 3.50 mm.

In the process of growing sugar beet seeds, one cannot achieve the desired results on the quality of seed under due to high degree of its quality diversity caused by the biological characteristics of the crop (the phase of sugar beet seed plants flowering takes place not evenly during 20 40 days depending on the weather conditions in cultivation areas). That is why all breeding and seed companies in the world and in our country as well prepare of the sugar beet seeds for sowing in the seed plants only. During the pre-sowing preparation, it is a very difficult technological chain including the seed stimulation. All technological operations aim at receiving the maximum of seed quality.

The program of scientific-research work of Institute of Bioenergy Crops and Sugar Beet aims on the establishing factors contributing to rapid seed germination at low temperatures and developing method of seed preparation on seed plants with high germination and reliability, which ensures high field germination and accelerated development of young plants in the field. It is known that the field germination of seeds depends on many factors and, primarily, on the laboratory germination of the sown seeds, which, in its turn, depends on several factors, biological features of a hybrid, soil and climatic conditions of seeds growing, and post-harvest and presowing preparation.

As we know, not all of the seeds give stairs after sowing. According to the data by Ovcharov K.E. [12], some species need shell removal for seeds to germinate, others inhibitors reducing the content, some metabolites enrichment, and for others the influence of water, light, temperature, and other physical factors is necessary. The response reaction of seeds on the above-mentioned actions depends on the natural species of seeds and their physiological state, and conditional germination. Almost all of the above-mentioned methods of increasing germination intensity are applied to sugar beet seeds.

We applied two methods of stimulating increase of the intensity of germ germination of sugar beet seeds, mechanical way by reducing the mechanical obstacle seed pericarp, which is achieved by seeds polishing and by the initial phases of germination with its following suspension passing initiation. The latter is one of the most perspective ways of increasing the intensity of seed germination.

The process of studying the efficiency of stimulation by the mechanical way in order to reduce the seed injury and to increase the degree of seed polishing was carried out in stages.

It was established that in the process of uncalibrated seeds polishing, the removal of 26.7 percent of the mass of pericarp ensures a significant increase in the intensity of seed germination (Table 18.4).

Thus, in 48 h after seeding, 32 percent of fruits sprouted, which is 19 percent more than in the control, where the seeds are not polished. The similar dependence is observed in 72 and 96 h after seeding. Bsides even in 120 h after sowing the difference in the number of sprouted seeds was significant.

The repeated sequential polishing of seeds ensures the removal of pericarp mass up to 30.1 percent compared with the control, which contributed to the increase of its germination intensity especially in the early stages. The removal of 31.7 percent of pericarp mass causes a slight injury of the seed that does not affect its germination reducing intensity.

TABLE 18.4 The intensity of seed germination depending on the degree of polishing (average of 2011 2012)

Variant	Pericarp removed (%)	Germinated seeds in hours after sowing (%)				
		48	72	96% energy of germination	120	Germination
Control, the original sample	0	13	60	76	77	78
After 1 polishing	26.7	32	80	82	82	83
After 2 polishing	30.1	56	86	87	87	88
After 3 polishing	31.7	52	87	88	88	89
LSD_{05}	2.5	5.6	2.8	3.4	3.2	3.3

The final stage of seed preparation for pelleting is seeds polishing by the technological fractions and its sorting by specific mass. It was established that under seed polishing by the technological fraction with diameter of less than 3.75 mm, 5.3 percent of pericarp mass is removed and the intensity of germination in 72 h after seeding increases by 17 percent compared with the control (Table 18.5).

TABLE 18.5 The intensity of calibrated seeds germination depending on the degree of polishing (average of 2011 2012)

Variant	Pericarp removed (%)	Germinated seeds in hours after sowing (%)				
		48	72	96% energy of germination	120	Germination
Control, the original sample	0	13	60	76	77	78
Fraction of seeds < 3.75 mm in diameter						
Before polishing	0	24	71	74	74	74
After polishing	5.3	50	77	78	79	79
After the pneumatic table	0	34	98	99	99	99
Fraction of seeds > 3.75 mm in diameter						
Before polishing	0	27	85	88	89	89
After polishing	8.8	57	91	91	91	92
After the pneumatic table	0	59	98	98	98	99
LSD_{05}		3.3	2.4	2.7	2.5	2.5

The sorting of this seed according to its specific mass ensures obtaining calibrated seed with 99 percent germination, which is quite suitable for the preparation of high-quality pelleted seed. The similar results were obtained after the polishing and sorting by specific mass on the seed of technological fraction diameter more than 3.75 mm.

Along with the mechanical method of the seed germination intensity increase, we studied the possibility to improve it through the stimulation of the initial phases of passage of germination with its subsequent suspension.

To determine the optimum regime of stimulation, the research was carried out with the seed of two domestic triploid hybrids. As the results prove the hybrids Oleksandriia and Umans kyi ChS 97 reacted to the seed to the stimulation in different ways. Under the stimulating initial phases passage of germination of hybrid Oleksandriia, the optimal term at which the number of sprouted incrusted seeds through the 48 h after seeding was 22 percent higher, and its germination was 6 percent higher than on the control, which is the stimulation by the fourth regime. At the stimulation of the initial phases passage of germination of hybrid Umans kyi ChS 97 under all regimes, we did not obtain a positive result on seed germination. The intensity of germination in 48 h after sowing increased to 6 44 percent compared with the control. The essence revealed in the chapter as the materials for patenting are being prepared and only the results of laboratory tests are shown.

It is established that pelleting shell together with the protective preparations provides the mechanical barrier for seed germination, especially in the early stages 48 h after sowing. Under these conditions, the stimulation of seeds before its pelleting affects the intensity of pelleted seeds germination positively. In all the variants with stimulation, except the variant where the stimulation was performed under the first regime, the number of germinated seeds of both hybrids was higher than in the control.

The analysis of factors influencing the number of sprouted encrusted pelleted seeds in 48 h has showed that the share of factor stimulation impact is significantly increased, compared with the impact on the calibrating seed and made 30 percent, a hybrid factor 60 percent, other factors 10 percent (Figure 18.4).

The verification of the developed method of seed germination stimulation, which provides the awakening of germ in the early stages with its subsequent suspension in a production environment has confirmed the results of laboratory research on the efficiency of this method. The effectiveness of stimulation was checked in 12 parties of calibrated seed of diploid and triploid hybrids prepared for pelleting, which lost partially the energy of germination and germination in the process of storage.

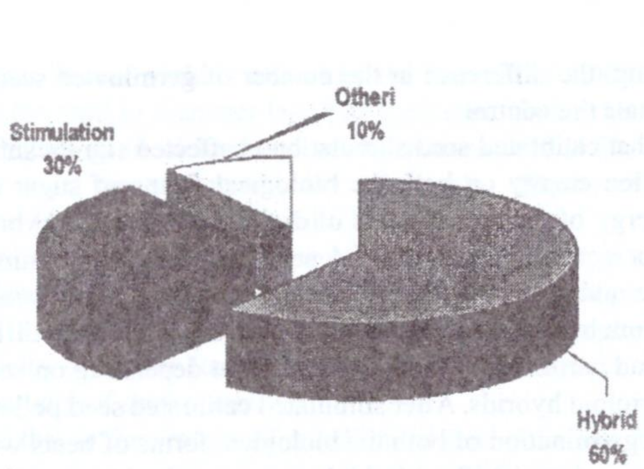

FIGURE 18.4 The share of factors influencing number of sprouted encrusted pelleted seeds in 48 h.

The seed stimulation ensures significant increase in the intensity of its germination of different sugar beet biological forms in the laboratory conditions (Figure 18.5.)

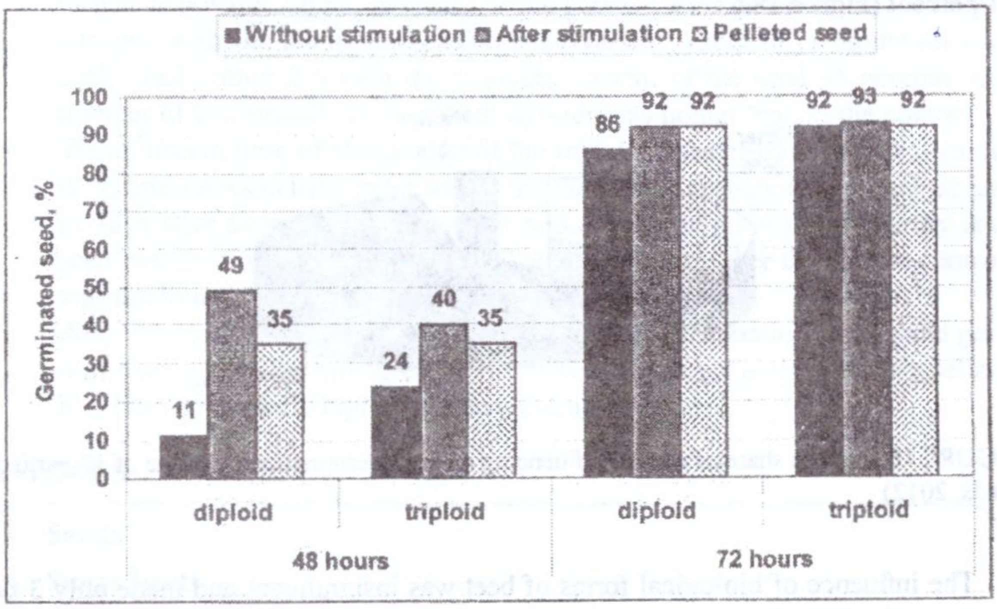

FIGURE 18.5 The intensity of seed germination of different biological forms depending on its stimulation (average of 12 parties of seeds, 2012).

Thus, if in 48 h after sowing 11 percent of calibrated seeds sprouted, then after the stimulation of diploid hybrids 49 or 38 percent more than in the control. Similar results were obtained by the triploid hybrids. After stimulated seeds pelleting, the intensity of its germination was significantly higher in the diploid and triploid sugar beets. Even 72 h after seeding, the intensity of calibrated and pelleted seed of diploid hybrids germination after the stimulation was higher than in the control. In triploid hybrids, 72 h after sowing, the difference in the number of germinated seeds was almost not observed or equals the control.

It is found that calibrated seed stimulation is affected significantly by the increase on its germination energy on both the biological forms of sugar beet. Thus, if the germination energy of calibrated seeds of diploid and triploid hybrids before stimulation was 90 percent, it increased by 4 percent (LSD_{05} stimulating factor = 1.2%) after stimulation and made 94 percent. Seed germination significantly increased after stimulation of both biological forms of sugar beet. No significant differences in germination energy and germination seed was found out depending on seed parties studied as diploid and triploid hybrids. After stimulated calibrated seed pelleting, the germination energy and germination of both the biological forms of beets were equal to those before the pelleting, but significantly higher compared with control. Thus, the germination energy and germination of pelleted seeds of diploid hybrids were identical and made 95 percent, which is 5 and 3 percent high than in the control, respectively, and in triploid hybrids these indexes of pelleted seeds were equal and made 94 percent, which is 4 and 2 percent more than in the control.

It was found out while determining the factors influencing on the laboratory germination of seeds that the stimulation of seed factor was the most significant and made 61 percent (Figure 18.6).

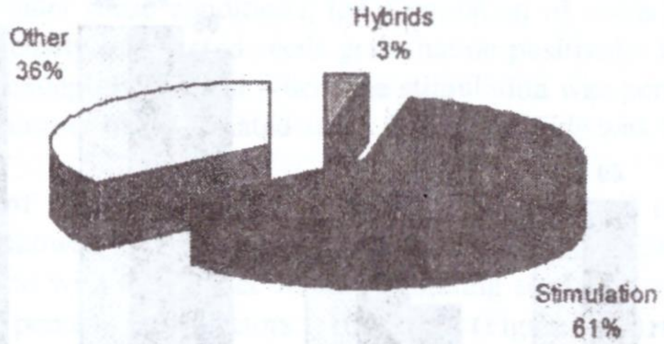

FIGURE 18.6 The share of factors influencing on seed germination (average of 12 parties of seeds, 2012).

The influence of biological forms of beet was insignificant and made only 3 percent, and the influence of other factors (presence of filled but dead fruit and others) was significant and made 36 percent.

18.4 CONCLUSIONS

- The directed regulation of flowering processes and flower formation of seed plants of mating components has a positive effect on the processes of growth and development and, especially, on the synchronization of flowering and the degree of tying seed and consequently its yield and quality. The yield of seed and its quality are significantly increased compared with the control (without minting) as a CMS component of the O-type.

- The increase in seed yield is caused by the increase of 1,000 seeds mass and decreases the seed in diameter less than 3.50 mm. Under the minting, we observed a higher yield of seed and sown fractions 3.50 4.50; 4.50 5.50 mm, especially under the minting of both components 50 percent of the plants of O-type and 100 percent of plants of CMS component.
- To regulate the process of plant growth and development, the components of the crossbreeding is advisable to perform the minting of 50 percent of fixative plant and 100 percent of plants of CMS component, which provides the largest synchronicity of flower formation and flowering of hybrid components and the productivity of seed plants.
- It is found that in the process of uncalibrated seed polishing, the removing of 24.7 percent of mass pericarp has provided significant increase in the intensity of seed germination. In 48 h after sowing, the number of seeds sprouted increased by 32 percent compared with the control, where the seeds are not polished.
- It is proved that the pelleting shell together with protective agents create a mechanical barrier to seed germination especially in the early stages in 48 h after sowing. Under these conditions, the stimulation of seed before pelleting effects is positive on the intensity of the pelleted seed germination. In all the variants with the stimulation, except the variant where the stimulation was performed within 2 h with the moisture content of the seed 35 percent, the number of germinated seeds of both hybrids was higher than in the control.
- The optimum time of stimulation of the initial phases passage of germination of hybrid Oleksandriia under which the number of sprouted encrusted tablets in 48 h after sowing was 22 percent higher and the germination energy and seed germination, respectively by 7 and 6 percent higher than in the control was the fourth regime of stimulation.
- After the stimulated calibrated pelleting seed, the germination energy and germination of both the biological forms of beet was equal to those before pelleting, but significantly higher compared with the control.

KEYWORDS

- **Seeds**
- **Sugar beets**
- **Minting**
- **Additional pollination**
- **Seed stimulation**
- **Germination**
- **Yield**