

**QUALITY OF SEED DISTRIBUTION AT DIFFERENT SPACES BETWEEN BASE AND INTERMEDIATE BASE**Doi: <http://dx.doi.org/10.1590/1809-4430-Eng.Agric.v37n1p128-135/2017>**LUIZ C. GARCIA<sup>1\*</sup>, PEDRO H. WEIRICH NETO<sup>2</sup>, ALTAIR JUSTINO<sup>2</sup>,  
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**ABSTRACT:** The aim of this study was to analyze the influence of space between the base and intermediate base on quality of seed distribution with a horizontal seed plate. The experiment was carried out in 2012 at the Laboratory of Agricultural Mechanization of the State University of Ponta Grossa - PR, Brazil, using a sowing simulation device. The experimental design was completely randomized design with four treatments and seven replications. Treatments consisted of spaces (0, 1, 2, and 3 mm) between the base and intermediate base. Replications were defined by 250 spacing between seeds. Corn (*Zea mays* L.), soybean (*Glycine max* L. Merrill), and sorghum (*Sorghum bicolor* Moench) seeds were tested. The analyzed variables were faulty, multiple and acceptable spacing. By increasing the space between base and intermediate base, quality of seed distribution was reduced for all species.

**KEYWORDS:** horizontal seed plate, *Glycine max*, seeder-fertilizer machine, *Sorghum bicolor*, *Zea mays*.

**INTRODUCTION**

Selecting and optimizing mechanized systems are the main objectives of rational mechanization. A proper purchase of an agricultural machinery is not sufficient if its use is not monitored in operational and financial aspects (PIACENTINI et al., 2012).

Agricultural mechanization can be related to activities of soil tillage, lime and gypsum application, basic fertilization, sowing, spraying of agrochemicals, topdressing, transport of inputs, water transport, harvesting and grain transport (JASPER & SILVA, 2013).

The functions of a seeder are to cut straw, open sowing furrow, deposit seeds at the bottom of the furrow, cover them with a layer of soil and compact the soil around them to ensure soil-seed contact. In the precision sowing, metering mechanism of a seeder has the function of metering regularly the seeds in the planting row, with pre-defined spacing (JASPER et al., 2011; MAO et al., 2015; WEIRICH NETO et al., 2012a).

Thus, sowing process seeks a uniform longitudinal distribution of seeds in the soil together with a correct depth of planting to reach the planned plant population (ALMEIDA et al., 2010). In addition, this is one of the stages requiring great perfection to be executed since it can compromise farming profitability (ROS et al., 2011).

Among the main seed distribution mechanisms in the precision seeders, a mechanical system with a horizontal seed plate stands out (WEIRICH NETO et al., 2015). A horizontal seed plate has holes for housing and metering seeds, in addition to being seated, along with the ring, between the base and intermediate base of seed reservoir. As the plate rotates, seeds occupy the holes and are led out of the reservoir and directed to the soil through the conducting tube (JASPER et al., 2006).

Working with different tangential velocities of metering plates of corn and soybean seeds on a carpeted belt, DIAS et al. (2014) obtained the best distribution at a tangential velocity of  $0.09 \text{ m s}^{-1}$  with about 5% of faulty and multiple spacing and 90% of acceptable spacing. When studying corn sowing in a no-tillage system with and without mechanical dry matter management in four properties and two agricultural seasons, WEIRICH NETO et al. (2012b) recorded an average of

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5.5% of faulty, 2.6% of multiple, and 91.6% of acceptable spacing.

Fertilizer positioning in corn sowing was studied by WEIRICH NETO et al. (2013), energy consumption in soybean sowing under straw of different plant species was analyzed by ZHAO et al. (2012), and VARNER et al. (2011) assessed economic issues of sorghum sowing in a conventional system and under straw. However, these authors did not find in the literature scientific papers examining the influence of space between the base and intermediate base on quality of seed distribution with horizontal seed plate. Thus, this study aimed at analyzing the influence of different spaces between the base and intermediate base on quality of seed distribution with a horizontal seed plate.

## MATERIAL AND METHODS

The experimental design was completely randomized design with four treatments and seven replications. Treatments were defined by changing the distance between the base and intermediate base (0, 1, 2, and 3 mm). A movable metallic ring fixed in the intermediate base and registered as Seajuste<sup>®</sup> (Figure 1) simulated the spaces between the base and intermediate base.

This study was developed on a bench of sowing process simulation, which presented a structure with support for coupling the metering system of a seeder, composed of a horizontal seed plate fixed in a metallic structure at the end of a belt of  $0.20 \times 9.66$  m. The metering system had an 8.3-mm enclosure for plate and ring fitting between the base and intermediate base.

Belt was forced by bench structure to acquire a “V” shape in the section where the conducting tube deposited the seed, minimizing seed longitudinal displacement along the belt. This system was powered by an electric motor of 0.735 kW (1.0 hp). Belt velocity was  $4.5 \text{ km h}^{-1}$ .

The bench was equipped with a photoelectric cell that recorded the number of holes in the horizontal plate that passed through the tube that conducted the seed from the metering mechanism to the belt. Conducting tube presented a length of 0.35 m and openings of  $45 \times 30$  mm (close to the plate) and  $30 \times 15$  mm (close to the belt). JASPER et al. (2009) validated this simulator bench with carpeted belt.

Seeds tested were corn (*Zea mays* L.), soybean (*Glycine max* L. Merrill), and sorghum (*Sorghum bicolor* Moench). Replications consisted of the measurement of 250 spacing between seeds in order to assess the regularity of distribution, as recommended by the standard ISO 7256/1 (ISO, 1984).

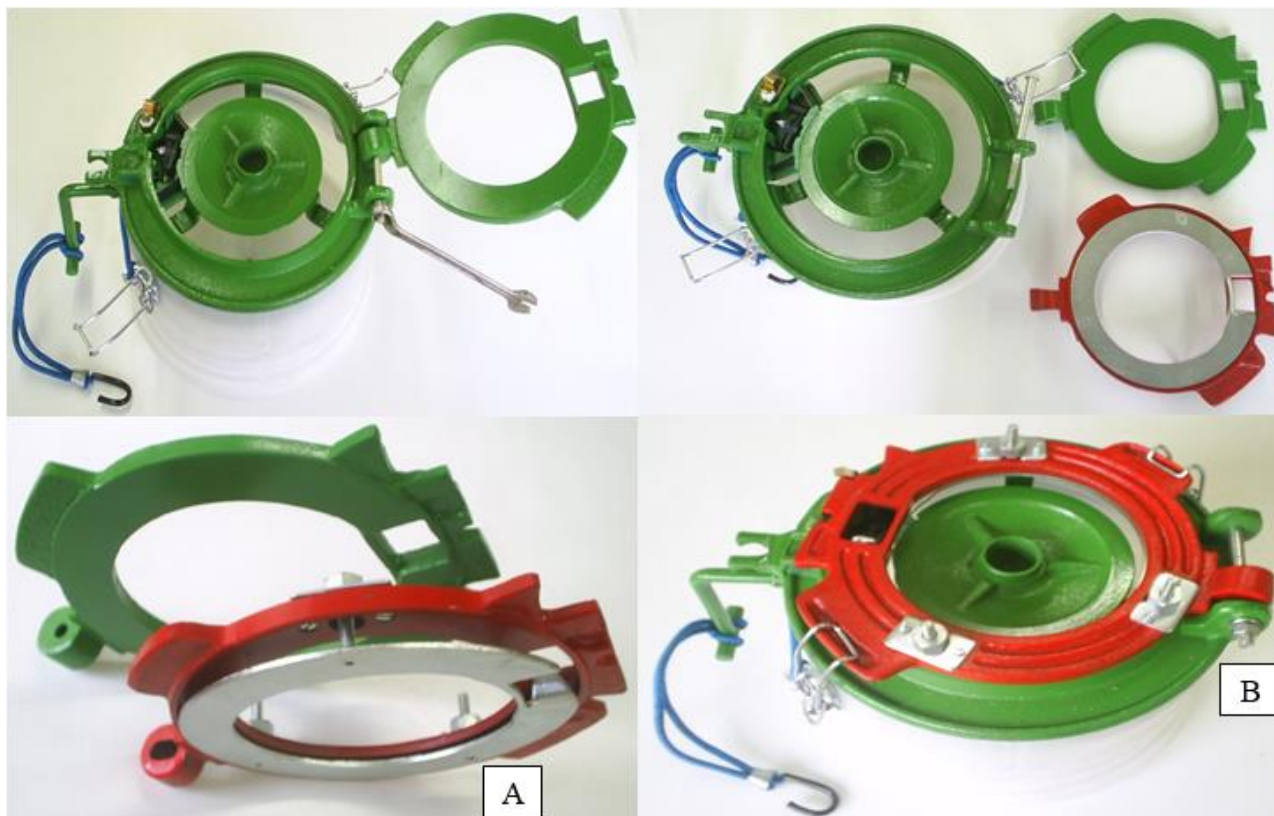


FIGURE 1. Movable metallic ring (A) fixed on the intermediate base (B) in order to control the space with the base where the ring and horizontal seed plate are housed.

Because presented a length of 9.66 m, the belt was stopped when full of seeds, with subsequent measurements in only seven meters. The mechanism was then activated for another three minutes and the distribution stopped for further measurements. This procedure was repeated until the spacing between 250 seeds was reached.

Corn seeds used were from a hybrid DOW<sup>®</sup> 2B707, lot XB1944A177, and sieve RC4. The bench of sowing simulation was regulated to distribute 3.5 seeds  $m^{-1}$ . Measurement of 100 seeds, using a Vonder<sup>®</sup> 150 mm metallic caliper, resulted in a length of 7.6 mm, width of 8.1 mm and thickness of 6.8 mm. An AMC9R<sup>®</sup> plate (28 round holes, a diameter of 189 mm and thickness of 4.3 mm) and a VD001<sup>®</sup> ring (diameter of 189 mm, thickness of 4 mm and recess of 2 mm) were used for seed distribution at a tangential velocity of 0.09  $m s^{-1}$ .

Soybean cultivar used was a COODETEC<sup>®</sup> 206 (sieve 06). The bench of sowing simulation was regulated to distribute 13 seeds  $m^{-1}$ . The average of 100 seeds presented a length of 7 mm, width of 6.2 mm and thickness of 5.1 mm. Seed metering set used was a plate VD 86.8<sup>®</sup> (86 round holes, a diameter of 189 mm and thickness of 5.3 mm) and a flat ring CZ 003 U<sup>®</sup> (diameter of 189 mm and thickness of 3 mm) at a tangential velocity of 0.11  $m s^{-1}$ .

Sorghum hybrid used was a VOLUMAX<sup>®</sup>, lot D1774 and sieve 05. The bench of sowing simulation was regulated to distribute 10 seeds  $m^{-1}$ . The average of 100 seeds measured presented a length of 4.4 mm, a width of 4.1 mm, and thickness of 3.1 mm. Metering set used was a plate CZ 5.0C<sup>®</sup> (52 round holes, diameter of 0.185 m, thickness of 4.3 mm, and side edge and recess of 2 mm) and a ring BR 006 D<sup>®</sup> (diameter of 189 mm, thickness of 4 mm and shoulder of 2 mm) at a tangential velocity of 0.14  $m s^{-1}$ .

The quality of longitudinal distribution was determined by the analysis of faulty, multiple and acceptable spacing. The assessment was based on the Standard Project 04:015.06–004/1995 (ABNT, 1996), which considers as acceptable all spacing between seeds from 0.5 to 1.5 times the average spacing. Values obtained out of this limit were considered as faulty spacing (above 1.5 times the average spacing) or multiples (below 0.5 times the average spacing).

Values recorded were submitted to Hartley test, to verify the homoscedasticity of variances, and to Shapiro-Wilk test, to examine the normality of data. For the analysis of variance, the F test was used with a confidence level higher than 95% probability. A polynomial regression was also applied in order to determine the best spacing between the base and intermediate base. The statistical software used was the Assistat®.

## RESULTS AND DISCUSSION

Variances of faulty, multiple and acceptable spacing presented homoscedasticity by Hartley test and normality by Shapiro-Wilk test for seed distribution in all species under study. Thus, data transformation was not used for the analysis of variance.

In corn crop, faulty spacing was below 1% in all spaces tested between the base and intermediate base. Thus, polynomial regression was not significant for this variable (Figure 2). Regarding multiple spacing, values increased in a quadratic manner as the spaces increased between the base and intermediate base, from 1.8%, with horizontal seed plate and ring working without clearance, to 75.4%, with 3 mm of space at the base of seed reservoir. This fact can be attributed to the action efficiency decrease of scraper trigger by the increase of the area between distribution box and horizontal seed plate.

Because faulty spacing did not change as the distance between the base and intermediate base was increased, acceptable spacing presented an inversely proportional behavior compared to multiple spacing. Thus, the horizontal seed plate and ring should work without clearance between base and intermediate base in order not to impair the longitudinal distribution of corn seeds.

These results corroborate the quality of distribution obtained by DIAS et al. (2014) on a bench with carpeted belt and by WEIRICH NETO et al. (2012b) in four properties and two agricultural seasons, with the distribution system working without clearance.

For soybean, polynomial regression was significant for the three variables studied (Figure 3). Faulty spacing was 4.1% with the system adjusted to 15.4% with 3 mm of space between the base and intermediate base. Faulty spacing presented a linear increase trend, with 99% of data represented by the equation.

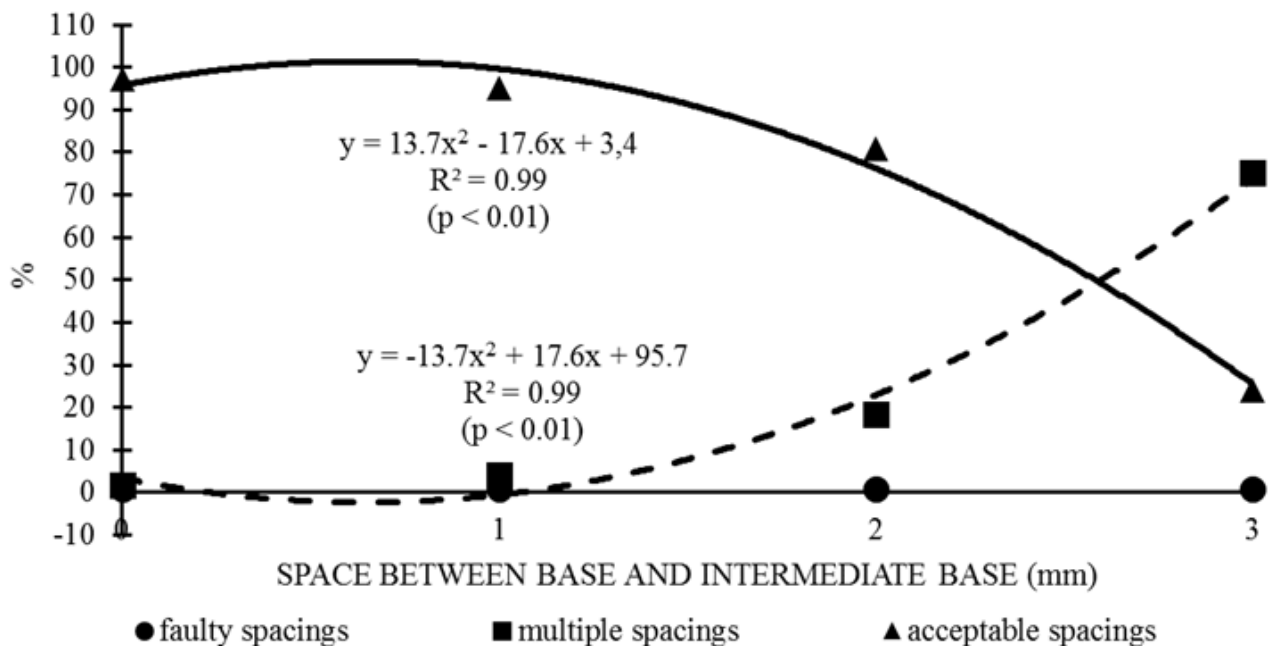


FIGURE 2. Quality of distribution of corn seeds DOW® 2B707 (lot XB1944A177 and sieve RC4) on a bench of sowing process simulation with a horizontal seed plate, with increasing spaces between the base and intermediate base.

Multiple spacing had similar behavior to faulty spacing, with increased values as the space between the base and intermediate base was increased. Values ranged from 5.1 to 14.8% for space at the base of the seed metering mechanism from 0 to 3 mm. At multiple spacing, this phenomenon, occurred for soybean grains, was adjusted by a quadratic equation from a polynomial regression.

When the metering system was adjusted and with a horizontal seed plate, acceptable spacing were 90.8%, which are close to values observed by DIAS et al. (2014), who studied the quality of soybean distribution on a bench with carpeted belt. As the space between the base and intermediate base was increased, values obtained reached 69.8%.

Again, scraper trigger action was affected by the increment in the area of activity. The largest space between the base and intermediate base can also cause a turbulence in soybean seeds that are in the fitting process of horizontal seed plate and ring, due to the circular movement of the metering system.

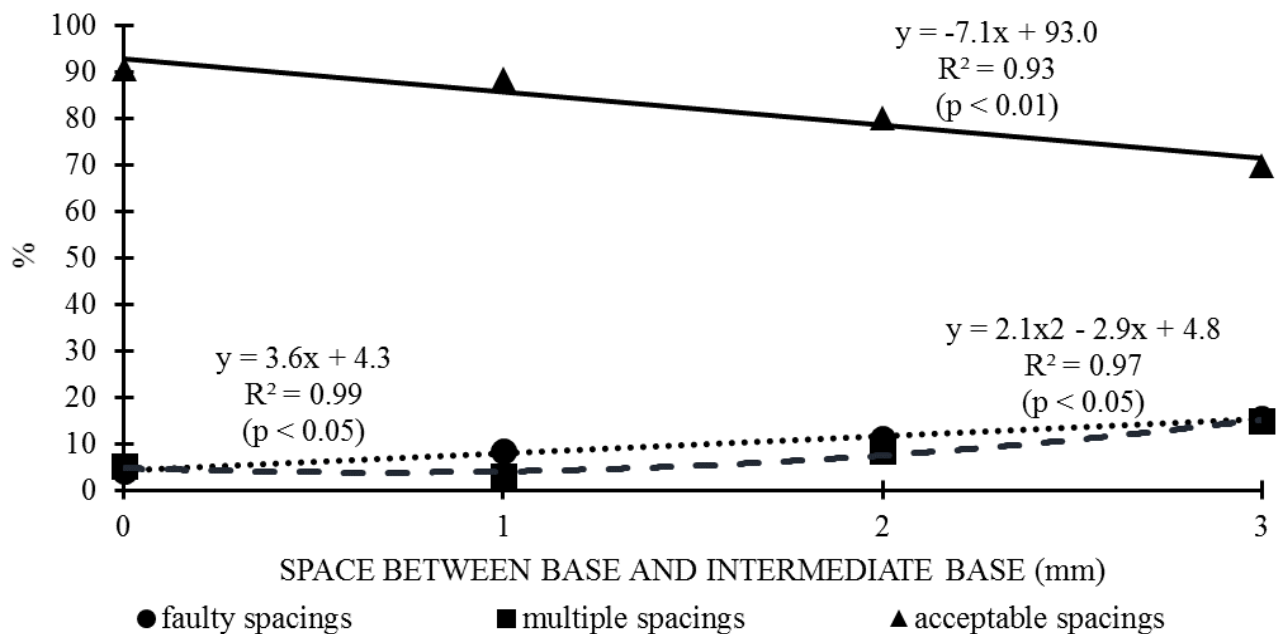


FIGURE 3. Quality of distribution of soybean seeds COODETEC® 206 (sieve 06) on a bench of sowing process simulation with a horizontal seed plate, with increasing spaces between the base and intermediate base.

When the metering system presented no clearance, quality of sorghum seed distribution was 0% for faulty spacing, 1% for multiple spacing, and 99% for acceptable spacing. However, when the space between the base and intermediate base was increased to 1 mm, faulty spacing remained at 0%, multiple spacing increased to 72% and those acceptable decreased to 28%. From the distance of 2 mm between the base and intermediate base, metering system damaged seeds, leading to stop their distribution (Figure 4).

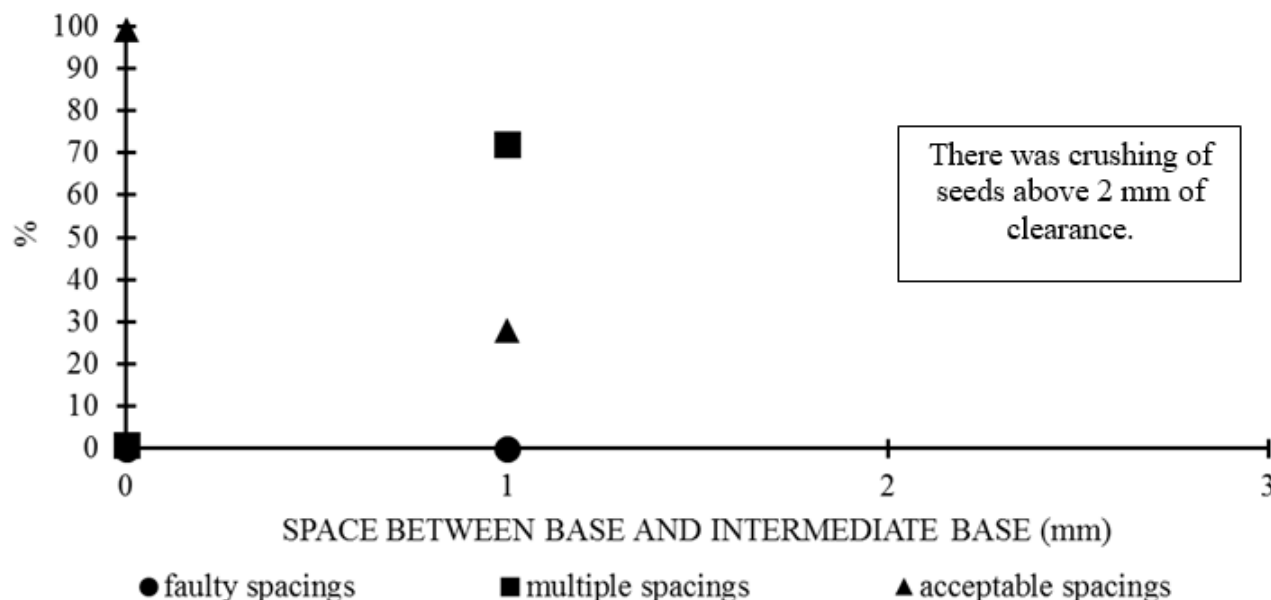


FIGURE 4. Quality of distribution of sorghum seeds VOLUMAX<sup>®</sup> (lot D1774 and sieve 05) on a bench of sowing process simulation with a horizontal seed plate, with increasing spaces between the base and intermediate base.

Because plate thickness and ring recess are dimensioned to accommodate seed thickness, an increase in the space between the base and intermediate base led to a reduction in the scraper trigger action of the distribution box and potentiated seed disorder due to the circular movement of the metering system, affecting the quality of seed distribution.

For corn seeds, a space between the base and intermediate base of 3 mm represented 44% of the average thickness of 6.8 mm of seeds used in the experiment. For soybean, this percentage was 59% and 97% for sorghum. Thus, an increase in the space between the base and intermediate base resulted in accuracy reduction of metering system by horizontal seed plate.

Seed thickness is not the only factor to be taken into account for the quality of distribution because soybean seeds, which have a smaller thickness than corn seeds, were less affected by the increase of the distance between the base and intermediate base compared to corn seeds.

## CONCLUSIONS

An increase in the space between the base and intermediate base reduced the quality of distribution with horizontal seed plate for seeds of corn, soybean, and sorghum.

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