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# ECONOMIC EVALUATION OF CONVENTIONAL AND TRANSGENIC CORN CULTIVARS IN THE NORTH AND WEST REGIONS OF THE STATE OF SÃO PAULO

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**Abstract:** More than 90% of the corn area in Brazil uses transgenic technology, but due to the loss of resistance to pests and a significant increase in seed prices, an economic comparison between transgenic and conventional materials is necessary. The objective was to study the production costs and profitability of the corn crop using conventional and transgenic cultivars in the North and West of SP. Average yield data obtained from regional trials of maize cultivars in five locations, consisting of 15 conventional and 17 transgenic cultivars, were used. With the Tukey test at 5%, the cultivars were allocated into three groups, classified as high, medium and low productivity. The cost structures involved effective operational cost (COE), and economic indicators. It was verified that in the groups of high and medium productivity, the COEs per hectare for the transgenic was superior to the conventional one and, because the average productivity of both were equivalent, the profitability index of the conventional one was higher than the transgenic one. In the group with low productivity, the transgenics produced more, and even so, the profitability indexes were very close (59.30% in the transgenic and 58.03% in the conventional). The largest percentage difference in COE occurred in the seed item. The variation in the production cost per bag of corn in the conventional one was R$ 16.31 (high), R$ 17.99 (medium) and R$ 20.53 (low) and in the transgenic R$ 17.66 (high), BRL 19.51 (average) and BRL 19.91 (low). It is concluded, under the conditions of the present study, that there was no statistical difference between the transgenic and conventional cultivars in terms of effective production cost.
**Keywords:** *Zea mays* L, grain yield, production cost, profitability.

## INTRODUCTION

The seed is the main input of a crop and the proper choice of it, must deserve all the attention of the producer, so that it is successful in its enterprise. According to data obtained directly from corn seed companies, for use in the 2015/16 harvest, 477 corn cultivars were made available, 284 of which were transgenic and 193 were conventional cultivars (Cruz et al., 2016). Even with many options in the choice of cultivars, "more than 90% of the planted corn area is cultivated with transgenic cultivars". Due to the loss of resistance to fall armyworm of most Bts technologies and the expressive increase in the price of transgenic seeds, interest in conventional corn cultivation has grown, but there are few economic studies to support the choice of the type of cultivar. This study aimed to evaluate the cost of production and the profitability of corn culture using conventional and transgenic corn cultivars in the North and West regions of the state of São Paulo.

## MATERIAL AND METHODS

Regional trials of IAC/APTA/CATI/ Empresas corn cultivars were installed in the 2015/16 summer crop (first crop), in the municipalities of Colina with altitude 580m, LVe1 soil, sowing on 11/27/2015 and harvest on 19 /04/2016; Riolândia with 420m, LVdf2, 12/11/2015 and 04/07/2016; Votuporanga with 480m, LVe, 11/30/2015 and 05/09/2016; Ituverava with 631m, LVdf, 11/25/2015 and 05/02/2016 and Adamantina with 450m, LVe 12/02/2015 and 05/15/2016. In all places there is adequate rainfall for the crop. For the present work, the average of grain yield from the joint analysis of all tests was used.

The experimental design was randomized blocks with four replications. The experimental plots were composed of four rows of five meters spaced at 0.8 m, using the two central rows as a useful area where the grain yield was evaluated.

Thirty-two cultivars were evaluated, 15 of which were conventional: JM 2M60, JM 3M51, JM 2M77, JM 2M80, 60XB14, IAC 9007, IAC 8046, 20A78, XB 8018, IAC 8390, IAC 8077, AL Avaré, AL Paraguaçu (2013), AL Bandeirante and AL Piratininga and 17 transgenics: MG 652 PW, AG 8088 PRO2, 2B610 PW, MG 699 PW, MG 580 PW, DKB 310 PRO2, 2B 810 PW, 2B 587 PW, 30A37 PW, BG 7037 H, AS 1633 PRO2, DKB 290 PRO3, Status VIP3, AG 8780 PRO3, AG 8677 PRO2, DKB 390 PRO2 and DKB 177 RR.

In most places, conventional soil preparation was used. In the planting fertilization, 370 kg ha -1 of formula 8-28-16 were applied, and two top dressings were applied, the first with the formula 20-5-20 and the second with ammonium sulfate, at doses of 330 kg ha $^{-1}$. The seeds were treated with the insecticide Tiamethoxam (Cruizer) against soil pests. The initial population was 62,500 plants per hectare. The application of the herbicide Glyphosate at a dose of 1.0 L/100 L of H20 in pre-sowing and Primestra Gold at the same dose in pre-emergence of weeds were also carried out, avoiding weed competition during the critical period of the crop. The spraying with insecticides was carried out as follows: two applications in conventional cultivars and one for the transgenic ones, using the insecticides Pirate, 0.500 L ha-1 and Premium 0.130L ha-1 in the first spraying and Cepermethrin 0.100L ha-1 and, Turbo 0.100L ha-1 in the second. Grain yield in bags/ha was corrected for 13% moisture.

The methodology for cost determination was based on Matsunaga et al. (1976), thus, the effective operational cost (COE) is the sum of expenses with labor, machinery, equipment, inputs and post-harvest.

Unit costs and profits were also determined, according to Martin et al.

(1998), with the following indicators for the analysis of economic viability: 1) Gross margin over COE = Gross Margin (COE): it is the margin in relation to the effective operating cost (COE), that is, the result that remains after the producer pays the effective operational cost considering a certain unit sales price and the yield of the production system for the activity. Simply put, we have: Gross Margin (COE) = [(RB - COE) / COE) x 100] where: RB = Gross Revenue; COE = Effective Operating Cost; 2) Leveling Point (COE) = COE / Pu (average unit price received). This indicator shows, given the sales price and the yield of the production system considered by activity, how much production is costing in product units and, if compared to yield, how many product units are left over to remunerate the other costs; 3) Operating Profit (LO): constitutes the difference between gross revenue and effective operating cost per hectare and measures the short-term profitability of the activity, showing the financial and operating conditions of the agricultural activity; 4) Profitability Index (IL): this indicator shows the relationship between operating profit (LO) and gross revenue, in percentage. It is an important measure of profitability of the agricultural activity, since it shows the available rate of income of the activity, after payment of all effective operational costs.

To determine costs and economic indicators, yield results obtained for conventional and transgenic cultivars were used, establishing three groups of cultivars from the comparison of means by the Tukey test at 5%. The first group was composed of cultivars of high productivity with an average of 9,751 kg ha1, (JM 2M60, MG652 PW, AG 8088 PRO2, 2B610 PW, MG699PW, MG 580 PW, DKB 310PRO2, 2B810 PW, 2B587 PW, 30A37 PW, BG 7037 H AS 1633 PRO2, DKB 290PRO3, JM 3M51 and JM 2M77 the second represented by medium yield cultivars with 8,875 kg ha-1, (Status VIP3, AG 8780 PRO3, JM 2M80, XB 6014, IAC 9007, IAC 8046, AG8677PRO2 , 20A78, XB 8018 and DKB 390PRO2 and the third with the cultivars that presented the lowest productivity values with an average of 7,550 kgha-1 (low), a fact already expected that most genetic materials are varieties (DKB 177 RR, IAC 8390 , IAC 8077, AL Avaré, AL Paraguaçu (2013), AL Bandeirante and AL Piratininga)

Thus, in terms of both productivity and seed price, the averages of the aforementioned ranges or groups were adopted.

## RESULTS AND DISCUSSION

For the feasibility of using the best hybrid, the evaluation of physical productivity is not enough, but economic analysis must be added, because these variables are fundamental to the decision-making of producers and technicians. From the results (Table 1), it was found that in the high productivity group, the COE per hectare for the transgenic was 8.6% higher than for the conventional one.

However, because the average productivity of transgenics and conventionals were statistically equivalent, the profitability index of the conventional was higher than the transgenic (66.65% and 63.88%) (Table 2).

In the medium yield group, the scenario was repeated, with equal yields, with the profitability index of the conventional one being higher than the transgenic one (63.21% and 60.10%) (Tables 1 and 2). The average price of seeds in the high productivity group: was R$ 493.04 (trans) and R$ 190.00 (conv), in the medium group: productivity was R$ 524.42 (trans) and R$ 197.70 (conv) and low productivity was R$349.00 (trans) and R$91.67 (conv), which shows us a similarity between the values in the high and medium productivity levels, both for transgenic and for conventional. Therefore, the choice of

| | Produtividade | | | | | |
|---|---|---|---|---|---|---|
| | High | | Medium | | Low | |
| **Plantation** | Transg | Conv | Transg | Conv | Transg | Conv |
| **Mechanized operation** | 434,08 | 485,91 | 434,08 | 485,91 | 434,08 | 485,91 |
| **Manual operation** | 56,22 | 60,91 | 56,22 | 60,91 | 56,22 | 60,91 |
| **Inputs** | xxx | Xxx | xxx | xxx | xxx | xxx |
| Seeds | 493,04 | 190,00 | 524,42 | 197,70 | 349,00 | 91,67 |
| Fertilizer | 1.502,70 | 1.502,70 | 1.502,70 | 1.502,70 | 1.502,70 | 1.502,70 |
| Defensives | 387,08 | 403,13 | 387,08 | 403,13 | 387,08 | 403,13 |
| **Total** | 2.382,83 | 2.095,83 | 2.414,21 | 2.103,53 | 2.238,78 | 1.997,50 |
| **COE** | 2.873,13 | 2.642,65 | 2.904,51 | 2.650,35 | 2.729,09 | 2.544,32 |

Op. Mec = mechanized operations; Op. Man = manual operations and COE = Effective operating cost.

Table 1. Production costs, in R$/ha, of transgenic and conventional corn cultivars of high, medium and low productivity. First crop 2015/16.

| | Unit | High production transgenic [1] | Conventional High production [2] | Transgenic - Medium production [3] | Conventional Average production [4] | GMO Low production [5] | Conventional Low production [6] |
|---|---|---|---|---|---|---|---|
| COE[7] | R$/ha | 2.873,13 | 2.642,65 | 2.904,51 | 2650,35 | 2.279,09 | 2.544,32 |
| Prod.[8] | sc/ha | 162,65 | 162,02 | 148,84 | 147,29 | 137,09 | 123,95 |
| P.M.U.R.[9] | R$/ha | 48,91 | 48,91 | 48,91 | 48,91 | 48,91 | 48,91 |
| R.Bruta[10] | R$/ha | 7.955,21 | 7.924,39 | 7.279,76 | 7.203,95 | 6.705,07 | 6.062,39 |
| M.Bruta[11] | % | 176,88 | 199,87 | 150,64 | 171,81 | 145,69 | 138,28 |
| C.Unit[12]. | R$/sc | 17,66 | 16,31 | 19,51 | 17,99 | 19,91 | 20,53 |
| L.Unit. [13] | R$/sc | 31,25 | 32,60 | 29,40 | 30,92 | 29,00 | 28,38 |
| P.Niv. [14] | Sc/ha | 58,74 | 54,03 | 59,38 | 54,19 | 55,80 | 52,02 |
| L.Op. [15] | R$/ha | 5.082,07 | 5.281,93 | 4.375,35 | 4.553,69 | 3.975,90 | 3.518,30 |
| I.Lucrat.[16] | % | 63,88 | 66,65 | 60,10 | 63,21 | 59,30 | 58,03 |

High production transgenic plantation, [2] Conventional high production plantation, [3] medium-yielding transgenic, [4] cultivate conventional medium production, [5] transgenic plantation.

Table 2. Comparison of economic indicators for the production of high, medium and low productivity transgenic and conventional corn cultivars. First crop 2015/16.

a regionally adapted cultivar results in an increase in productivity without increasing the cost of the seed item, ensuring increased profitability.

According to Carvalho et al. (2010) the greatest effects of transgenics, in economic terms, are the reduction of costs and the reduction of losses caused by biotic factors that act in the environment where these crops are grown. The gains from the cultivation of genetically modified organisms (GMO) are derived from the reduction in the cost of using pesticides and the increase in productivity caused by the control of pest infestation. However, due to the breakdown of fall armyworm resistance to most Bts transgenic technologies, this advantage has been small or non-existent.

In the group with low productivity, the average of the transgenics was superior to the conventional ones in terms of productivity (137 and 124 bags hectare-1) (Table 2), and the profitability index was 59.30% against 58.03% of the conventional. This is due to the fact that this group is composed of conventional varieties, which do not have hybrid vigor. In all groups, the highest percentage difference in COE occurred in the seed items, whereas the other items differed only in terms of an additional application of insecticide in conventional corn. Carvalho et al. (2010), analyzing the cost and productivity of transgenic and conventional corn, adopting the same technological level for both crops, in a no-tillage system, verified variations in seed price, in the number of insecticide applications, in the amount of cultural practices. and on the impact on productivity, according to the pressure of pests in the conventional corn area.

The variation in the production cost per sack of conventional corn in the groups was R$ 16.31 (high), R$ 17.99 (medium) and R$ 20.53 (low) and for the transgenic R$ 17.66 (high), BRL 19.51 (average) and BRL 19.91 (low).

Due to the high price of transgenic corn seeds in relation to the conventional one, it may be more advantageous to acquire a conventional single-hybrid seed with greater production potential than to acquire a transgenic single or triple hybrid seed.

## CONCLUSIONS

There was no statistically significant difference between the transgenic and conventional cultivars in terms of cost-effective production, under the conditions of the present study.

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