BILLET PLANTING RESEARCH

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Research continued to develop methods to maximize the chances of success with billet (stalk section) planting. During 2017, results were obtained from field experiments conducted at the Sugar Research Station at St. Gabriel evaluating the potential for seed-treatment chemicals to improve stand establishment and yield in billet plantings. Planting method tests comparing two billet planters and whole stalk hand planting and comparing tolerance to billet planting among varieties also were conducted at the Sugar Research Station.

Seed Treatment Chemicals

Chemical seed (billet) treatments continued to be evaluated in field experiments to determine whether they can increase yields obtained from billet plantings in Louisiana. Results were obtained from on-going and newly established experiments comparing different varieties, treatments, and application methods.

Second ratoon results were obtained in a field experiment comparing HoCP 96-540 non-treated billets and whole stalks to billets dip treated with different seed treatment chemicals singly or in combinations. The experiment compared non-treated billets and whole stalks to billets receiving a dip application of Cruiser insecticide (thiamethoxam), Dynasty fungicide (axozystrobin, fludioxanil, and mefanoxam), Uniform fungicide (azoxystrobin and mefanoxam), QuadrisXtra fungicide (azoxystrobin and cyproconazole), Cruiser + Dynasty, Cruiser + Uniform, Cruiser + QuadrisXtra, and the disinfectant Pinesol. The concentrations of the insecticide and fungicides in the dip solutions were reduced to approximate commercial label rates, and the fungicides were adjusted to have similar concentrations of active ingredients for one fungicide, azoxystrobin. The rates for each chemical were 11.5 oz/acre formulated product of Cruiser (0.3% in the dip solution), 27.7 oz/acre of Dynasty (0.72% dip), 6.5 oz/acre of Uniform (0.17% dip), and 10.4 oz/acre of QuadrisXtra (0.27% dip). Pinesol was diluted at the recommended rate of ¼ cup (60 ml) per gallon of water (1.6% solution). The seed treatment chemical experiments are conducted in cooperation with Dr. Paul White of the USDA-ARS Sugarcane Research Unit.

Differences were detected among treatments for cane tonnage and total sugar yield in plant cane (Table 1). All chemical treatments had comparable cane tonnage to whole stalks, and all had higher tonnage than non-treated billets, except for the fungicides Dynasty and Uniform applied alone. All chemical treatments had comparable total sugar yield to whole stalks and a higher yield than non-treated billets, except Dynasty alone and Cruiser + QuadrisXtra. Pinesol total sugar yield was lower than for all treatments, except for non-treated billets. Only two of the insecticide/fungicide combination treatments, Cruiser + Uniform and Cruiser + Quadris Xtra, still had higher cane tonnage and sugar yields than non-treated billets in first ratoon, while whole stalk and non-treated billet yields were similar (Table 1). Few differences were detected among treatments in second ratoon in this experiment (Table 1). There were unexpected yield decreases in some treatments, particularly for the Cruiser + Dynasty treatment; however, the experiment was adversely affected by an uneven high infestation with johnsongrass in that affected the results. Overall, the results were similar to previous experiments with the most beneficial treatments for billets being obtained with the insecticide plus fungicide dips.

Table 1. Cane tonnage and total sugar yields for HoCP 96-540 billets planted with and without treatment with different combinations of seed-treatment chemicals and non-treated whole stalks in 2015 plant cane, 2016 first ratoon, and 2017 second ratoon in a field experiment at the Sugar Research Station.

	Plant cane		First ratoon		Second ratoon	
Treatment	Tons cane/A[1]	Sugar/A (lbs.)[1]	Tons cane/A[1]	Sugar/A (lbs.)[1]	Tons cane/A[1]	Sugar/A (lbs.)[1]
Non-treated billets	34.5 de	7,638 d	28.2 cd	5,534 bc	23.4 abc	5,141 abc
Non-treated whole stalks	47.8 abc	10,640 ab	29.0 bc	5,742 ab	24.0 abc	5,389 abc
Cruiser dip	42.5 bc	9,192 bcd	28.8 bc	5,657 ab	17.4 bcd	4,051 bcd
Dynasty dip	40.2 cd	8,434 cd	27.0 cd	5,146 bc	20.4 bcd	4,537 bcd
Uniform dip	42.0 bcd	9,526 bc	26.2 cd	5,035 bc	26.7 ab	6,068 ab
QuadrisXtra dip	51.0 a	11,560 a	27.5 cd	5,531 bc	22.5 abc	5,080 abc
Cruiser + Dynasty	47.5 abc	10,507 ab	28.8 bc	5,721 ab	11.1 d	2,568 d
Cruiser + Uniform	49.5 ab	11,169 a	34.8 ab	6,988 a	31.2 a	6,925 a
Cruiser + QuadrisXtra	53.0 a	11,886 a	35.8 a	7,021 a	17.1 cd	3,763 cd
Pinesol	28.2 e	5,856 e	22.5 d	4,266 c	19.2 bcd	4,356 bcd

[1]Mean values within a column followed by the same letter were not significantly different (*P*=0.05). A = acre.

First ratoon yields were obtained in a field experiment comparing HoCP 96-540 non-treated billets and whole stalks to billets dip treated with seed treatment chemicals singly or in combinations. The treatments were non-treated billets, non-treated whole stalks, Platinum 75 SG insecticide (thiamethoxam 75%) at 5.67 oz (weight)/acre, Uniform fungicide (azoxystrobin 28.2% and mefenoxam 10.9%) at 6.5 oz/acre, Quilt Xcel fungicide (azoxystrobin 13.5% and propiconazole 11.7%) at 20 oz/acre, Quadris fungicide (azoxystrobin 22.9%) at 11.5 oz/acre, Platinum + Uniform, Platinum + Quilt Xcel, Platinum + Quadris, Xanthion fungicide at 1.2 oz/acre (component A) and 6 oz/acre (component B), and the disinfectant Pinesol at 60 ml/gal (1.6%).

Differences were detected in plant cane among treatments for cane tonnage and total sugar yields (Table 2). Five treatments, including Platinum (insecticide), Xanthion and the three insecticide/fungicide treatments, Platinum + Uniform, Platinum + Quilt Xcel, and Platinum + Quadris, had equivalent cane tonnage yields to the whole stalk planting. All of those treatments with the exception of Xanthion had higher tonnage and total sugar yield than non-treated billets. In first ratoon, cane tonnage was still lower for non-treated billets compared to whole stalks, while the fungicide and insecticide treatments were similar to whole stalks, except for Quadris alone (Table 2). Similar results were obtained for total sugar per acre, except Uniform alone and Pinesol also produced a lower yield than whole stalks.

Table 2. Comparison of 2016 plant cane and 2017 first ratoon cane tonnage and total sugar yields for HoCP 96-540 billets planted with and without treatment with different combinations of seed-treatment chemicals and non-treated whole stalks in a field experiment at the Sugar Research Station.

Variety and treatment	Tons cane/acre[1] Plant cane	Sugar/acre (lbs.)[1] Plant cane	Tons cane/acre[1] First ratoon	Sugar/acre (lbs.)[1] First ratoon
Non-treated billets	30.7 d	6,640 c	31.3 b	6,881 b
Non-treated whole stalks	47.0 a	10,497 a	44.0 a	9,582 a
Platinum dip	43.6 abc	9,603 ab	38.3 ab	8,498 ab
Uniform dip	32.1 d	7,063 c	34.9 ab	7,532 b
Quilt Xcel dip	35.4 bcd	7,898 bc	38.2 ab	8,249 ab
Quadris dip	34.7 cd	7,580 bc	34.2 b	7,791 b
Platinum + Uniform	43.1 abc	9,370 ab	35.9 ab	7,860 ab
Platinum + Quilt Xcel	45.1 ab	9,583 ab	39.3 ab	8,432 ab
Platinum + Quadris	43.7 abc	9,666 ab	39.7 ab	8,441 ab
Xanthion	36.9 abcd	7,960 bc	38.0 ab	8,079 ab
Pinesol	32.5 d	7,040 c	36.1 ab	7,776 b

[1]Mean values within a column followed by the same letter were not significantly different (P=0.05).

The 2017 plant cane experiment compared HoCP 96-540 non-treated billets and whole stalks to billets dip treated with seed treatment chemicals singly or in combinations. The treatments were non-treated billets, non-treated whole stalks, Platinum 75 SG insecticide (thiamethoxam 75%) at 5.67 oz (weight)/acre, Abound (Quadris) fungicide (azoxystrobin 22.9%) at 11.5 oz/acre, Quilt Xcel fungicide (azoxystrobin 13.5% and propiconazole 11.7%) at 20 oz/acre, Headline fungicide (pyraclostrobin 23.6%) 11.5 oz/acre, Priaxor fungicide (fluxapyroxad 14.33% and pyraclostrobin 28.58%), Platinum + Abound, Platinum + Quilt Xcel, Platinum + Headline, Platinum + Priaxor, and Pinesol at 60 ml/gal (1.6%).

Stand establishment and plant cane yield components were determined and compared. Differences were detected mainly among treatments for initial fall shoot populations, spring shoot populations, whereas few differences were detected for millable stalk populations (Table 3). Initial shoot populations during the fall were higher for whole stalks and the Platinum + Priaxor treatment compared to non-treated billets. The Abound, Platinum + Abound, Platinum + Quilt Xcel, and Platinum + Headline treatments had fall stands equivalent to whole stalks, while the Pinesol treatment had a lower population than non-treated billets. Following a very dry fall and an erratic winter, the Platinum + Quilt Xcel, Platinum + Priaxor, and Platinum + Headline treatments had spring shoot populations equivalent to the whole stalk planting. Platinum + Abound, Abound, Priaxor, and Headline treatments had spring populations equivalent to whole stalks. Pinesol still had a lower population than non-treated billets. Millable stalk populations were similar among treatments, except Pinesol was lower than whole stalks and all of the insecticide fungicide combination treatments.

Table 3. Comparison of plant cane fall (primary) shoot, spring shoot, and millable stalk populations for HoCP 96-540 billets with and without dip treatment with different combinations of seed-treatment chemicals and whole stalks in a field experiment conducted at the Sugar Research Station during 2017.

Treatment	Fall shoots/acre[1]	Spring shoot population/acre[1]	Millable stalks per acre[1]
Non-treated billets	9,760 cd	45,487 cd	44,023 abc
Non-treated whole stalks	12,584 a	59,185 a	45,103 ab
Platinum dip	8,609 de	41,862 de	42,698 bc
Quadris dip	10,596 abcd	49,007 abcd	43,500 abc
Quilt Xcel dip	10,143 bcd	47,369 bcd	43,640 abc
Headline dip	10,073 bcd	51,935 abcd	43,709 abc
Priaxor dip	10,317 bcd	52,946 abc	42,559 bc
Platinum+Quadris	11,886 abc	55,455 abc	46,777 ab
Platinum+Quilt Xcel	11,816 abc	57,268 ab	44,894 ab
Platinum+Priaxor	12,165 ab	58,976 a	46,533 ab
Platinum+Headline	10,596 abcd	57,024 ab	47,648 a
Pinesol	6,658 e	34,647 e	39,457 c

[1]Mean values within a column followed by the same letter were not significantly different (*P*=0.05).

Differences were detected for some yield components among the treatments (Table 4). The only difference detected for stalk weight was Pinesol was greater than Platinum + Priaxor. No differences were detected among treatments for commercially recoverable sugar. Four treatments, whole stalks, Platinum + Abound, Platinum + Priaxor, and Platinum + Headline had higher cane tonnage than non-treated billets. Four other treatments, Platinum + Quilt Xcel, Platinum, Priaxor, and Headline were equivalent to whole stalks, while Quilt Xcel and Abound applied alone were lower than whole stalks. Pinesol was again lower than non-treated billets. Results were similar for total sugar per acre yield, except whole stalk yield was similar to non-treated billets.

The seed treatment chemicals continue to show the potential to increase stands and stalk populations in billet plantings that result in increased cane tonnage and total sugar yield. The results continue to indicate that the most consistent benefit comes from dip application of combinations of insecticide and fungicides. A dip application of Pinesol has resulted in lower stands and yields in three experiments suggesting that it does not have a beneficial effect on planted billets, rather it is detrimental. The results with the seed-treatment chemicals are promising, and the research will be continued. Developing an application method that will give similar beneficial results to a dip but be feasible in commercial planting systems is a high priority.

Table 4. Comparison of plant cane yield components for HoCP 96-540 billets with and without dip treatment with different combinations of seed-treatment chemicals and whole stalks in a field experiment at the Sugar Research Station during 2017.

Treatment	Stalk weight (lbs.)[1]	Sugar/ton cane (lbs.)[1]	Tons cane/acre[1]	Sugar/acre (lbs.)[1]
Non-treated billets	2.30 ab	222.9	44.2 cd	9,879 cd
Non-treated whole stalks	2.42 ab	225.7	49.5 ab	11,155 abc
Platinum dip	2.42 ab	231.2	45.2 bcd	10,386 abcd
Quadris dip	2.25 b	227.8	42.0 d	9,594 d
Quilt Xcel dip	2.31 ab	233.6	43.2 cd	10,099 bcd
Headline dip	2.18 b	232.3	46.5 abcd	10,743 abcd
Priaxor dip	2.32 ab	232.9	47.2 abc	11,015 abc
Platinum+Quadris	2.32 ab	229.4	51.0 a	11,697 a
Platinum+Quilt Xcel	2.28 b	227.2	47.2 abc	10,766 abcd
Platinum+Priaxor	2.17 b	227.0	50.2 ab	11,456 a
Platinum+Headline	2.36 ab	225.6	50.2 ab	11,378 ab
Pinesol	2.42 ab	227.4	34.8 e	7,925 e

[1]Mean values within a column followed by the same letter were not significantly different (P=0.05). No letters are shown when all means were similar.

Planting Method Experiments

The first experiment to compare two billet planting methods to hand whole stalk planting was harvested in second ratoon during 2017. Two varieties, HoCP 96-540 and HoCP 04-838, were included with two planting dates. Billets were planted with a conventional drum planter in which billets are metered under the drum into a single open furrow or with a double-drill planter in which billets are carried over the top and through two funnels into each of two narrow drills opened in the 70 inch row. Whole stalks were hand-planted at a rate of three stalks and a lap. The experiment was planted with two planting dates (August 26 and October 9, 2014). All planting method experiments have been conducted in cooperation with Dr. Paul White of the USDA-ARS Sugarcane Research Unit.

Results were similar in plant cane and first ratoon for both HoCP 96-540 and HoCP 04-838 for the August planting date (Table 5). Whole stalk cane tonnage and total sugar yields were higher for whole stalk than for both billet planting methods, except the double-drilled billets had a similar total sugar yield to whole stalks for HoCP 96-540 in first ratoon. Yields were similar for all treatments in second ratoon, except double-drilled billets had a lower cane tonnage yield for HoCP 04-838. For the October planting date (Table 6), cane tonnage and total sugar yields were higher for the double-drilled billets and similar to whole stalks for both varieties in plant cane and HoCP 96-540 in first ratoon. Yields were similar for both cane tonnage and total sugar in second ratoon, except that drum/open furrow billets had a lower tonnage yield than whole stalks.

First ratoon results were obtained from a field experiment with two planting dates (September 1 and 23, 2015) comparing the two billet planting methods and whole stalk planting. Differences in plant cane yield components were detected among the planting methods and varieties in both plantings. However, the outcomes of the two plantings were extremely different with the second planting being adversely affected by an extended drought period before and after planting followed by extended wet soil conditions. In the first planting, cane tonnage and total sugar yields were higher for the whole stalk planting than both billet plantings for HoCP 96-540, but the double-drilled billet yields were higher than open-furrow billets and equivalent to the whole stalk yields for HoCP 04-838 (Table 7). In the second planting, adverse weather conditions resulted in severe problems with stand establishment, particularly for the billet plantings of HoCP 96-540. Double-drilled billets had higher cane tonnage and total sugar yields than open-furrow planted billets but lower yields than for whole stalks (Table 7). HoCP 04-838 billet plantings were less affected by the adverse weather conditions, and the double-drilled billet cane tonnage yield was higher than for non-treated billets and equivalent to whole stalks. However, total sugar yields were lower for both billet plantings compared to whole stalks. Only the early planting date was continued to first ratoon. Results were similar among treatments within varieties, except drum/open furrow billets had a lower tonnage yield than both double-drilled billets and whole stalks (Table 7).

Table 5. Planting method comparison results for plant cane, first ratoon, and second ratoon yield components of HoCP 96-540 and HoCP 04-838 planted as billets with a conventional drum planter in an open furrow, billets planted in a double-drill, and hand-planted whole stalks in a field experiment conducted at the Sugar Research Station during 2017 (planted August 26, 2014).

Variety and treatment	Tons cane/acre[1]	Sugar/acre (lbs.)[1]	Tons cane/acre[1]	Sugar/acre (lbs.)[1]	Tons cane/acre[1]	Sugar/acre (lbs.)[1]
	Plant cane	Plant cane	First ratoon	First ratoon	Second ratoon	Second ratoon
HoCP 96-540						
Double-drill billets	41.1 b	9,074 b	26.7 b	4,899 abc	17.7 c	3,345 c
Drum planter/open-furrow billets	38.0 bc	8,461 bc	26.6 b	4,707 bc	18.6 bc	3,447 c
Whole stalk hand-plant	47.4 a	10,644 a	29.9 a	5,425 a	21.9 bc	4,075 bc
HoCP 04-838						
Double-drill billets	34.3 cd	7,645 cd	23.4 c	4,428 c	22.1 bc	4,553 ab
Drum planter/open-furrow billets	32.1 d	6,949 d	23.2 c	4,410 c	23.2 ab	4,884 ab
Whole stalk hand-plant	40.3 b	9,005 b	28.1 ab	5,354 ab	27.2 a	5,455 a

[1]Mean values within a column followed by the same letter were not significantly different (*P*=0.05).

Table 6. Planting method comparison results for plant cane, first ratoon, and second ratoon yield components of HoCP 96-540 and HoCP 04-838 planted as billets with a conventional drum planter in an open furrow, billets planted in a double-drill, and hand-planted whole stalks in a field experiment conducted at the Sugar Research Station during 2017 (planted October 9, 2014).

Variety and treatment	Tons cane/acre[1]	Sugar/acre (lbs.)[1]	Tons cane/acre[1]	Sugar/acre (lbs.)[1]	Tons cane/acre[1]	Sugar/acre (lbs.)[1]
	Plant cane	Plant cane	First ratoon	First ratoon	Second ratoon	Second ratoon
HoCP 96-540						
Double-drill billets	38.0 b	7,943 bc	31.0 a	6,334 a	29.6 ab	5, 482
Drum planter/open-furrow billets	33.0 cd	7,089 bc	27.6 bc	5,404 bc	26.0 bc	5,029
Whole stalk hand-plant	43.2 a	9,351 a	30.7 ab	6,130 ab	29.9 a	5,518
HoCP 04-838						
Double-drill billets	36.7 bc	7,965 b	24.4 c	5,150 c	25.6 c	5,140
Drum planter/open-furrow billets	32.2 d	6,897 c	24.4 c	5,077 c	25.6 c	5,252
Whole stalk hand-plant	38.7 b	8,027 b	26.2 c	5,369 bc	26.2 bc	5,264

[1]Mean values within a column followed by the same letter were not significantly different (*P*=0.05). No letters are shown when all means were similar.

An experiment compared the two billet planting methods and whole stalk planting for HoCP 96-540 and HoCP 09-804 in plant cane during 2017. The planting rates for the billets were determined as number of billets and the weight of cane in the open furrow or for both drills combined. The planting rate assessed as number of billets in the furrow and cane tonnage was higher for double-drilled billets than open furrow billets and whole stalks, and open furrow billets were higher than whole stalks of both varieties (Table 8). The amount of physical damage caused by the harvester and two planters was determined and compared (Table 9). Bud damage was greater after passage through both planters for HoCP 09-804, and internode damage was less for the double-drill planter compared to the conventional under-the-drum planter.

Drought conditions following planting resulted in poor stand establish in the experiment, particularly for HoCP 96-540. Stalk weight and commercially recoverable sugar were similar for all planting methods within varieties (Table 10). Cane tonnage and total sugar yields were low for both varieties and differences were detected among treatments (Table 10). For HoCP 96-540, tonnage was lower for double-drilled billets than the other two methods, while tonnage and sugar yields were not significantly different for open furrow billets and whole stalks. For HoCP 09-

804, tonnage and total sugar yields were lower for both billet planting methods compared to whole stalks.

Table 7. Planting method comparison results for plant cane and first ratoon yield components of HoCP 96-540 and HoCP 04-838 planted as billets with a conventional drum planter in an open furrow, billets planted in a double-drill, and hand-planted whole stalks in a field experiment conducted at the Sugar Research Station during 2017 (planted September 29, 2016).

Variety and treatment	Tons cane/acre[1]	Sugar/acre (lbs.)[1]	Tons cane/acre[1]	Sugar/acre (lbs.)[1]
	Plant cane	Plant cane	First ratoon	First ratoon
HoCP 96-540				
Double-drill billets	38.8 b	6,950 ab	27.7 ab	5,099 a
Drum planter/open-furrow billets	36.8 bc	6,753 b	24.1 abc	4,482 ab
Whole stalk hand-plant	42.0 a	7,366 a	27.8 a	5,161 a
HoCP 04-838				
Double-drill billets	36.3 c	6,896 ab	22.0 c	4,140 b
Drum planter/open-furrow billets	33.4 d	6,096 c	20.6 d	3,956 b
Whole stalk hand-plant	36.1 c	6,711 b	23.6 bc	4,596 ab

[1]Mean values within a column followed by the same letter were not significantly different (*P*=0.05).

Table 8. Planting method comparison results for planting rates as determined by number of billets in the row furrow or cane weight for HoCP 96-540 and HoCP 09-804 planted at two dates as billets with a conventional drum planter in an open furrow, billets planted in a double-drill, and hand-planted whole stalks in a field experiment conducted at the Sugar Research Station during 2017 (planting date September 29, 2016).

Variety	Method[1]	Planting rate[2]	Cane weight[2]
HoCP 96-540	Open furrow	6.7 a	9.99 a
HoCP 96-540	Double-drill	4.9 b	7.64 b
HoCP 96-540	Whole stalk	0.6 c	4.6 c
HoCP 09-804	Open furrow	7.6 a	9.1 a
HoCP 09-804	Double-drill	5.4 b	7.1 b
HoCP 09-804	Whole stalk	0.5 c	4.6 c

[1]Billets were machine-planted in an open furrow or in a double-drill, and whole stalks were hand-planted in an open furrow.
[2]Planting rate was estimated as the number of seedcane billets or stalks per foot of row or by the tons of cane planted per acre. Mean values within a column followed by the same letter were not significantly different (*P*=0.05).

Table 9. Planting method comparison results for billet characteristics determined for HoCP 96-540 and HoCP 09-804 after cutting with a mechanical harvester and then after passing through the conventional drum planter or the double-drill planter for a field experiment planted at the Sugar Research Station during 2016 (planting date September 29, 2016).

		Billet characteristics[1]				
Time of evaluation	Variety	Length (inches)	Number of buds/billet	Number of damaged buds	Number of damaged internodes	Billets with no damage
After harvester	HoCP96-540	19.2	3.2 ab	0.12 c	0.44 b	64%
After drum planter	HoCP96-540	18.9	3.3 ab	0.10 c	0.56 ab	54%
After double-drill planter	HoCP96-540	19.5	3.4 ab	0.12 c	0.64 ab	38%
After harvester	HoCP09-804	19.8	3.5 ab	0.35 b	0.6 ab	38%
After drum planter	HoCP09-804	19.7	3.2 b	0.72 a	0.82 a	26%
After double-drill planter	HoCP09-804	19.9	3.6 a	0.64 a	0.52 b	46%

[1]Mean values within a column followed by the same letter were not significantly different (*P*=0.05). No letters are shown when all means were similar.

Table 10. Planting method comparison results for plant cane yield components of HoCP 96-540 and HoCP 09-804 planted as billets with a conventional drum planter in an open furrow, billets planted in a double-drill, and hand-planted whole stalks in a field experiment conducted at the Sugar Research Station during 2017 (planted September 29, 2016).

Variety and treatment	Stalk weight (lbs.)[1]	Sugar/ton cane (lbs.)[1]	Tons cane/acre[1]	Sugar/acre (lbs.)[1]
HoCP 96-540				
Double-drill billets	2.13 abc	211.7 c	5.2 c	1,091 c
Drum planter/open-furrow billets	2.42 a	213.4 bc	11.4 b	2,429 bc
Whole stalk hand-plant	2.21 ab	213.2 bc	15.6 b	3,624 b
HoCP 09-804				
Double-drill billets	1.83 cd	224.4 ab	13.1 b	3,024 b
Drum planter/open-furrow billets	1.97 bcd	227.5 a	15.6 b	3,569 b
Whole stalk hand-plant	1.65 d	230.5 a	23.1 a	5,321 a

[1]Mean values within a column followed by the same letter were not significantly different (*P*=0.05).

Considering the results altogether, double-drill planting of billets in a traditional row has the potential to produce higher yields than open furrow billet planting. Double-drill planting can preserve moisture in the row, and it may allow wider utilization of the row top. Stressful environmental conditions, especially drought after planting, have occurred in two of three seasons, and all experiments have been planted in heavy clay soils, as well. Under these conditions, HoCP 04-838 and HoCP 09-804 have exhibited better tolerance of billet planting than HoCP 96-540.