The Relationship of Seed and Cell Size to Planter Performance

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DIFFICULTIES ARISING from variations in the physical characteristics of sugar beet seed has lead to a study of planter performance as it is affected by the seed. Quite often actual seeding rates obtained in the field do not correspond to the calculated seeding rate, and emergence patterns have indicated that something has happened in the planting process which was not foreseen. A break down of some of the variables involved indicates that at least part of the trouble can be traced to the wide variation in seed size fractions within a given size range, and perhaps to differences in density due to different methods or sequences used in processing the whole seed. Some of the difficulties encountered can be traced to variations in the metering devices of planters where the planter cell volume varies a great deal between planters. This cell variation along with the wide range in seed size may account for some of the variations in the field.

If 7- to 10/64-inch processed seed is being considered, it can readily be shown that a large percentage of seed in the 7- to 8/64-inch size range may nearly double the number of seeds planted per acre compared with seed containing a high percentage in the 9- to 10/64-inch bracket. A sphere 10/64 inch in diameter contains 2.914 times the volume of a sphere 7/64 inch in diameter and very often two 7/64 seeds will be picked up in a seed-plate cell which was intended to pick up and drop only one seed piece. In addition to planting more seed pieces than desired, this has the added disadvantage of grinding and damaging the pieces planted. Apparently, from the test conducted, a small increase in plate cell size increases the percentage of cell fill very rapidly when the seed used contains a high percentage of the small sizes.

A test to determine cell fill as affected by plate speed and seed size was conducted in the laboratory using as many commercial planters as could be obtained. The physical characteristics of the seed are shown in table 1 and it was with this seed that the cell fill and plate speed tests were made. The results of this test are shown in table 3 and figures 1 to 11. Table 2 shows the results of plate cell fill for three different plate-type planters using a constant plate speed and changing the size of seed and the method of processing.

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Table 1. Physical characteristics of seed.

Great Western Decorticated Seed No. 268
7/64 inch to 10/64 inch, 45,880 Seedballs per pound

Seed size fractions	
Over 10/64 inch	0.7 percent
9/64 inch to 10/64 inch	13.3 percent
8/64 inch to 9/64 inch	45.0 percent
7/64 inch to 8/64 inch	35.1 percent
Under 7/64 inch	5.9 percent
Total	100.0 percent

Table 2.—Cell fill and seed size.

American Crystal Seed
Cell fill for John Deere No. 64 Planter
Cell diameter .168 inch
Plate speed 55 ft./min.

Kind and size of seed	Cell fill percent	Seedballs per pound	Seed damage* percent
Decorticated 7-10/64 seed	89.0	32,760	1.45
Segmented 7-10/64 (before gravity table)	99.2	46,960	2.50
Segmented 9-10/64 (before gravity table)	90.5	37,440	.55
Segmented 8-9/64 (before gravity table)	97.5	48,250	1.31
Segmented 7-8/64 (before gravity table)	142.5	61,160	11.30
Segmented 7-10/64 (after gravity table)	83.0	40,070	1.60

Cell fill for International 40 Planter
Cell diameter 11/64 inch

Plate speed 50 ft./min.

Kind and size of seed	Cell fill percent	Seedballs per pound	Seed damage* percent
Decorticated 7-10/64	104.0	32,760	0.42
Segmented 7-10/64 (before gravity table)	128.5	46,960	0.97
Segmented 9-10/64 (before gravity table)	105.0	37,440	0.47
Segmented 8-9/64 (before gravity table)	134.0	48,250	0.48
Segmented 7-8/64 (before gravity table)	219.0	61,160	2.24
Segmented 7-10/64 (after gravity table)	110.5	40,070	1.45

Cell fill for Rassmann Planter
Cell diameter 11/64 inch

Plate speed 35 ft./min.

Kind and size of seed	Cell fill percent	Seedballs per pound	Seed damage* percent
Decorticated 7-10/64	96.3	32,760	0.98
Segmented 7-10/64 (before gravity table)	117.3	46,960	2.89
Segmented 9-10/64 (before gravity table)	97.4	37,440	1.11
Segmented 8-9/64 (before gravity table)	125.0	48,250	2.80
Segmented 7-8/64 (before gravity table)	164.0	61,160	3.78
Segmented 7-10/64 (after gravity table)	99.5	40,070	1.75

*Percent passing through a 6/64 round-hole screen.

Table 3. Cell fill and seed damage.
Data obtained from 10-minute runs with seed hoppers one-half full.

Planter	Plate speed ft./minute	Percent cell fill	Percent seed damage
John Deere No. 55	10	135.7	3.88
	20	130.7	4.16
	40	117.8	3.34
	60	111.0	2.90
	80	106.0	2.42
	100	101.4	3.32
	140	90.1	3.63
	180	76.4	3.87
John Deere No. 64	10	111.0	7.21
	20	111.3	8.15
	40	100.5	6.32
	60	97.8	6.17
	80	89.8	4.78
	100	82.8	4.04
	140	63.7	5.02
	180	43.7	5.07
International Harvester Company No. 40	10	154.7	7.70
	20	153.3	6.99
	40	144.0	6.40
	60	153.8	6.30
	80	127.0	6.10
	100	116.8	6.44
	140	93.5	6.20
	180	85.0	8.54
Paul Milton	10	148.3	11.54
	20	147.3	9.7
	40	127.8	10.45
	60	122.0	8.65
	80	107.3	7.59
	100	77.8	5.37
	140	64.4	8.49
	180	47.8	9.80
Rassmann	10	106.1	8.25
	20	106.1	6.42
	40	99.0	4.13
	60	85.0	4.94
	80	73.8	5.11
	100	63.6	6.89
	140	46.6	5.82
	180	36.6	8.56
Olson	10	No data	No data
	20	94.4	2.19
	40	70.0	1.97
	60	73.7	2.49
	80	55.3	1.56
	100	53.6	2.63
	140	25.9	2.66
	180	16.6	4.57
Planet Jr.	12.9	129.2	2.32
	20	104.6	7.41
	40	46.8	8.34
	60	34.8	7.41
	80	22.7	2.13
	100	15.1	2.56
	140	8.02	3.45
	180	4.74	4.54

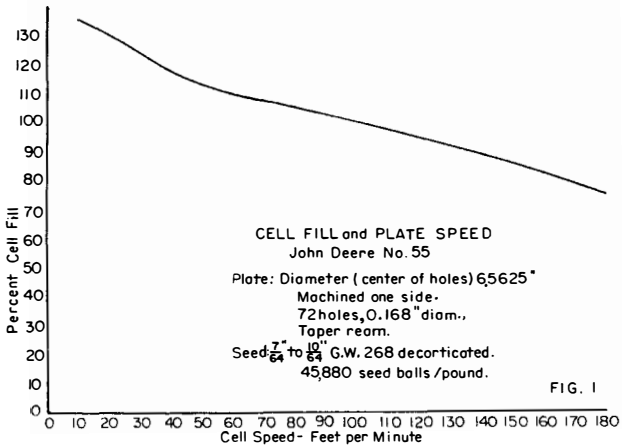

Percent Cell Fill
130
120
110
100
90
80
70
60
50
40
30
20
10
0
CELL FILL and PLATE SPEED
John Deere No. 55
Plate: Diameter (center of holes) 6.5625"
Machined one side.
72 holes, 0.168" diam.,
Taper ream.
Seed 7/64" to 10/64" G.W. 268 decorticated.
45,880 seed balls/pound.
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180
Cell Speed - Feet per Minute

FIG. 1

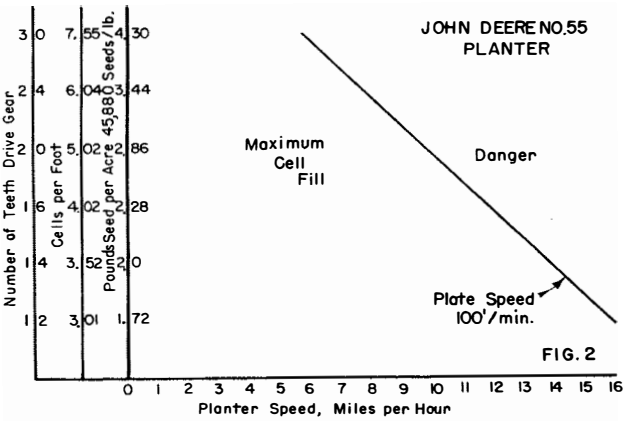
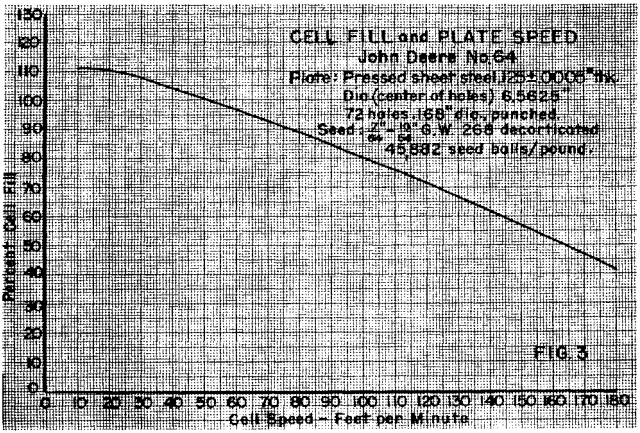
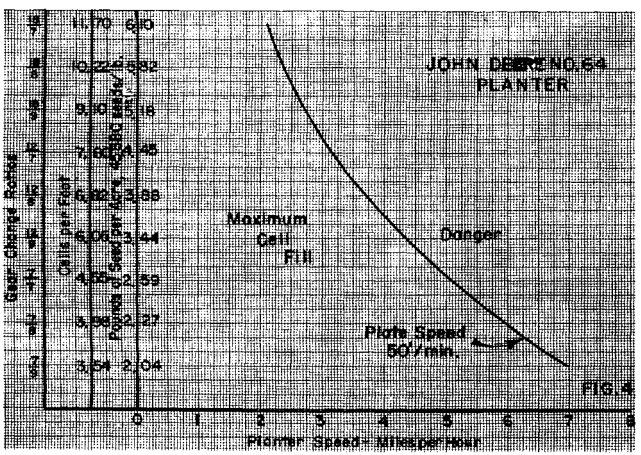
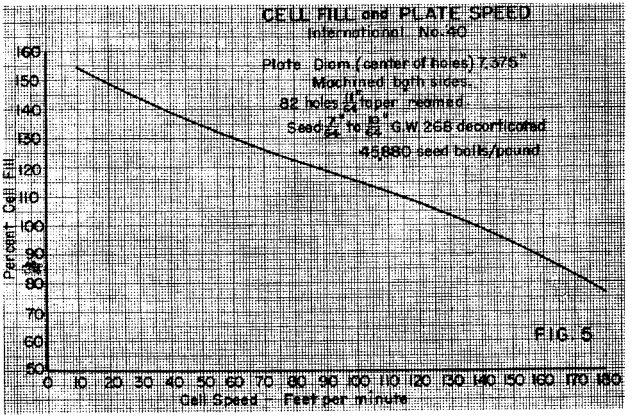
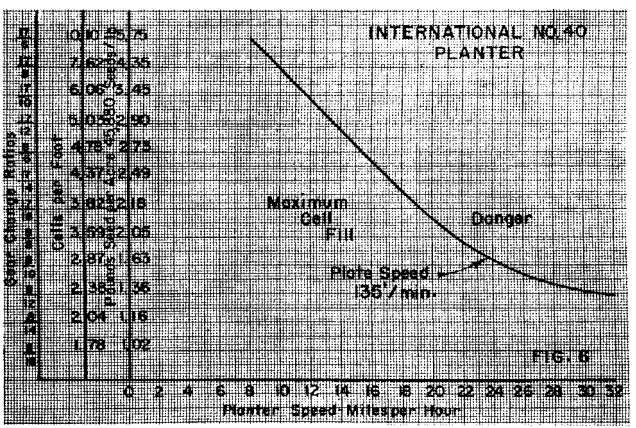

Number of Teeth Drive Gear
30 24 20 16 14 12
Cells per Foot
7.55 6.04 5.02 4.02 3.52 3.01
Pounds Seed per Acre 45,880 Seeds/lb.
4.30 3.44 2.86 2.28 2.0 1.72
JOHN DEERE NO. 55
PLANTER
Maximum
Cell
Fill
Danger
Plate Speed
100'/min.
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Planter Speed, Miles per Hour

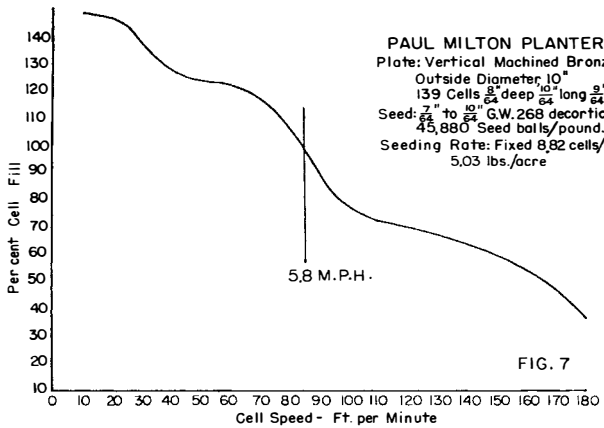
FIG. 2

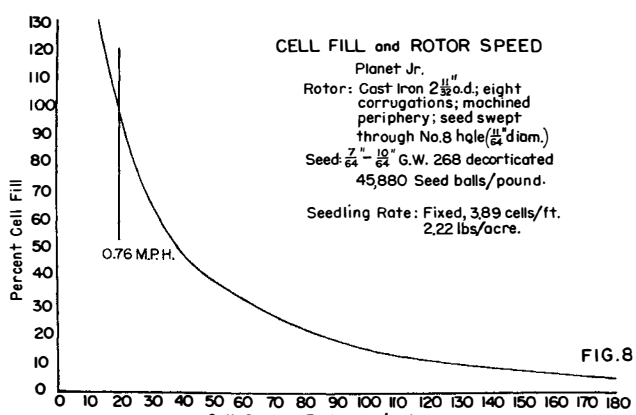

CELL FILL and PLATE SPEED
John Deere No.64
Plate: Pressed sheet steel .125±.0005" thk.
Dia (center of holes) 6.5625"
72 holes .168" dia. punched
Seed: 2"-16 G.W. 268 decorticated
45,582 seed balls/pound
Percent Cell Fill
Cell Speed - Feet per Minute
FIG. 3


JOHN DEERE NO.64
PLANTER
Maximum
Cell
Fill
Danger
Plate Speed
50/min.
Gear Change Ratio
Cells per Revolution
Seeds per Revolution
Planter Speed - Miles per Hour
FIG. 4


CELL FILL and PLATE SPEED
International No. 40
Plate Diam. (center of holes) 7.375"
Machined both sides.
82 holes 11/64 taper reamed.
Seed 7/64" to 9/64" G.W 268 decorticated
45,880 seed bolts/pound
Percent Cell Fill
Cell Speed — Feet per minute
FIG. 5


INTERNATIONAL NO. 40
PLANTER
Maximum
Cell
Fill
Danger
Plate Speed
135 r/min.
Planter Speed-Miles per Hour
FIG. 6


PAUL MILTON PLANTER
Plate: Vertical Machined Bronze
Outside Diameter 10"
139 Cells 8/64" deep 10/64" long 9/64" wide
Seed: 7/64" to 10/64" G.W. 268 decorticated
45,880 Seed balls/pound.
Seeding Rate: Fixed 8.82 cells/ft.
5.03 lbs./acre
5.8 M.P.H.
Per cent Cell Fill
Cell Speed - Ft. per Minute
FIG. 7


CELL FILL and ROTOR SPEED
Planet Jr.
Rotor: Cast Iron 2 11/32 o.d.; eight corrugations; machined periphery; seed swept through No.8 hole (11/64" diam.)
Seed: 7/64" - 10/64" G.W. 268 decorticated
45,880 Seed balls/pound.
Seedling Rate: Fixed, 3.89 cells/ft.
2.22 lbs./acre.
0.76 M.P.H.
Percent Cell Fill
Cell Speed - Feet per minute
FIG. 8

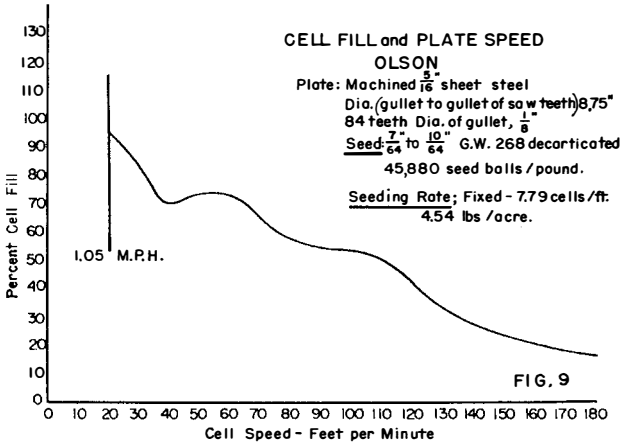

CELL FILL and PLATE SPEED
OLSON
Plate: Machined 5/16" sheet steel
Dia. (gullet to gullet of saw teeth) 8.75"
84 teeth Dia. of gullet, 1/8"
Seed: 7/64" to 10/64" G.W. 268 decorticated
45,880 seed balls / pound.
Seeding Rate; Fixed - 7.79 cells/ft.
4.54 lbs /acre.
1.05 M.P.H.
Percent Cell Fill
Cell Speed - Feet per Minute
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180
0 10 20 30 40 50 60 70 80 90 100 110 120 130

FIG. 9

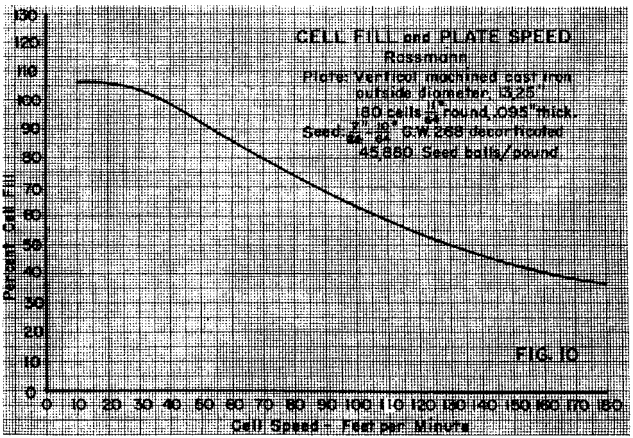

CELL FILL and PLATE SPEED
Rassmann
Plate: Vertical machined cast iron
outside diameter 13.25"
80 cells 11/64" round .095" thick.
Seed: 7/64" to 10/64" G.W. 268 decorticated
45,880 Seed balls/pound
Percent Cell Fill
Cell Speed - Feet per Minute
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180
0 10 20 30 40 50 60 70 80 90 100 110 120 130

FIG. 10

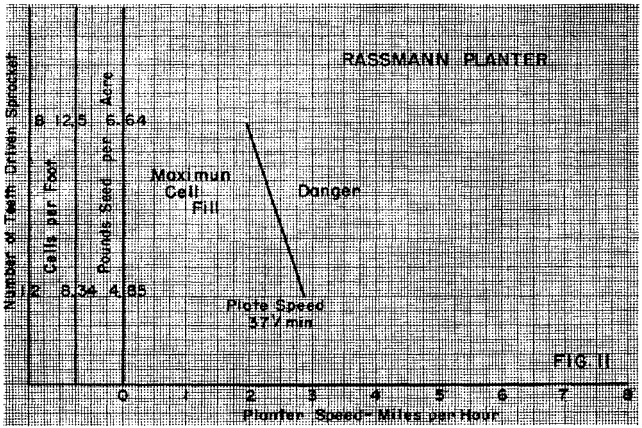
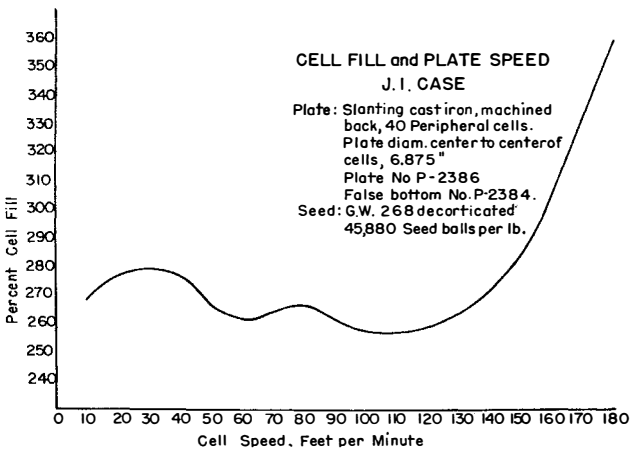

RASSMANN PLANTER
Number of Teeth Driven Sprocket
Cells per Foot
Pounds Seed per Acre
8 12.5 6.64
12 8.34 4.85
Maximun Cell Fill
Danger
Plate Speed 37 r min
0 1 2 3 4 5 6 7 8
Planter Speed- Miles per Hour

FIG. II


CELL FILL and PLATE SPEED
J. I. CASE
Plate: Slanting cast iron, machined back, 40 Peripheral cells.
Plate diam. center to center of cells, 6.875"
Plate No P-2386
False bottom No. P-2384.
Seed: G.W. 268 decorticated 45,880 Seed balls per lb.
Percent Cell Fill
360 350 340 330 320 310 300 290 280 270 260 250 240
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180
Cell Speed, Feet per Minute

Eight makes of planters were tested, but since the Case planter used was not a production model it will not be included in the report. The other seven are: John Deere No. 55, John Deere No. 64, International No. 40, Paul Milton, Planet Jr., Olson and Rassmann. Other planters would have been included if they could have been obtained in time for the test.

The seed in table 1 was Great Western No. 268 processed at the Sterling, Colorado, plant. It was decorticated 7- to 10/64-inch size having a rather high seedball count per pound. The seed used in table 2 was American Crystal processed at the Rocky Ford, Colorado, plant. The seed was run through the sampling machine at the Seed Laboratory of the Colorado Agricultural Experiment Station to get samples for seedball counts. All calculations were determined by weight on a sensitive balance after the seedball count had been made. The Great Western No. 268 seed had a seedball count of 45,880 per pound while the American Crystal decorticated sample which was tested had 32,760 seed pieces per pound. H. W. Dahlberg, Research Manager for The Great Western Sugar Company, says that different varieties will vary between themselves to this extent.

In general the cell fill for all plate planters was higher using 7- to 10/64-inch decorticated seed with the correspondingly larger plate cells this year than they were last year using 7- to 9/64-inch segmented seed and smaller cells. This seems to bear out the idea that wider ranges in seed size are used at the expense of precision planting. Table 3 summarizes the results of the plate speed and cell fill test and shows the corresponding seed damage. The seed damage was measured as the percentage of dust and broken particles which pass through a 6/64-inch round-hole screen after passing through the planter metering device.

The slope of the curve on the cell fill versus plate speed graphs indicates to some extent the sensitivity of the planter with respect to speed. In general the flatter the curve the less sensitive it is to increased speeds. The highest point on the curve at slowest speeds is some indication of how much too large the plate cell is for the seed being used. As an example, the 11/64-inch cell in the International No. 40 planter has a volume of 13.5 percent greater than the .168-inch cell in the John Deere No. 64 planter. At the very slow plate speed of 10 feet per minute both planters should pick up seed directly proportional to the volume of the planter cell. In this case the International had 154.7 percent cell fill and the John Deere 111 percent cell fill. This brings out the delicate relationship between seed size and cell size.

Table 2 again shows the effect of changing the size of seed on the percentage of cell fill. The International No. 40 in this case dropped more than twice as many seed pieces when 7- to 8/64-inch seed was used as it

did when 9- to 10/64-inch seed was in the hopper. The John Deere increased 55 percent using the small seed and the Rassmann increased 68 percent.

In the field where laboratory control is impossible it might be desirable to divide the present 7- to 10/64-inch seed into two sizes. One size, from 7- to 9/64-inch using a 10/64-inch plate cell for growers interested in the highest possible number of single-germ seeds and the other, from 9- to 10/64-inch using a 11/64-inch plate cell, for accurate planting of seed pieces slightly higher in sprout count. If the problem of seed processing and distribution were not too great, more accurate sizing would be definitely advantageous. It is quite evident that anything that could be done to produce a more uniform size of seed would be highly beneficial. Keeping the plate-cell size as small as possible to accommodate the largest seed in the size range will help. By using the smallest plate cell possible and low planter speeds a fairly good job of planting can be done.