CRITICAL PLATE SPEEDS OF SUGAR BEET PLANTERS

R. D. Barmington[1]

When the question of sugar beet planters is under discussion the subjects of cell fill and planter speeds are sure to come up. With the coming of high speed tractors and rubber tired planters it is difficult to judge accurately the speed at which the machine is traveling and the light draft of a four or six row planter makes it very easy for the operator to travel six or eight miles per hour.

Since little information is available on the effect of plate speed and the ability of the plate to pick up seed at various speeds, a series of tests have been conducted on the two basic types of plate planters, that is, horizontal and vertical plates. The tests have been conducted on the assumption that it is the speed at which a cell passes through a mass of seed which determines its ability to pick up seed rather than the number of cells which pass a given point in the seed box per second. That is, feet per minute, of the seed cell was used as one of the coordinates in judging performance rather than cells per second or cells per minute. This information was then converted into terms of miles per hour and pounds of seed per acre for each planter.

The metering devices from six commercial plate planters were tested. Three of them, John Deere No. 55, John Deere No. 66, and International Harvester Company No. 40, were of the horizontal plate type and three, the Cobley-Plantrol, Paul Milton and Rassmann were of the vertical plate type. All six were considered precision planters. The plates were all standard equipment with cells 10/64 inches in diameter with the exception of the Paul Milton planter which has 10/64 inches square cell openings that are 11/64 inches deep. Special jigs and speed reducing equipment were set up to secure plate speeds ranging from 10 feet per minute to 180 feet per minute. In a few cases it was impossible to get quite down to 10 feet per minute for the lowest speed. Five, ten minute runs were made at each speed with the level depth of seed over the plate at one, two, three, four and five inches respectively. The number of seeds for each run was determined by weight after a careful count and weight check had been made on the seed. The amount of grinding or seed damage was determined by weighing the amount of seed material which passed through a 6/64 inch round hole screen after going through the metering unit.

The seed used throughout the test was segmented U.S. 22 Improved prepared in the seed processing plant of the American Crystal Sugar Company at Rocky Ford, Colorado for the 1946 season. The seed was 7 to 9/64 inches in size with 36 percent passing through an 8/64 inch round hole screen and contained 45,300 seed pieces per pound.

Cell fill and seed damage are summarized in Table I. All planters tested showed a tendency toward minimum seed damage at a speed which gave 100 percent, or slightly less than 100 percent cell fill. When the plate speed was very slow and cell fill averaged 115 percent or more the seed damage was greater and when plates speeds were increased so that cell fill

[1] Associate Research Engineer, Colorado Agricultural Experiment Station

fell off materially the seed damage increased rather rapidly. The Cobley planter followed a slightly different pattern in that seed damage of about 11 percent was approximately constant up to the point where cell fill was 100 percent then increased rapidly with increased plate speeds.

All the graphs showing the relationship between plate speed and cell fill indicate the danger of using only one inch of seed in the seed can. In commercial planting this would rarely happen but in plot work it is often convenient to use a small amount of seed. Two inches of seed in the horizontal plate planters covered approximately half the plate in normal operation and gave equal and sometimes better cell fill than larger amounts of seed. Good cell fill can also be obtained with one inch of seed in the can if the seed is kept spread over at least half of the seed plate.

From Figure 1 it can be seen that plate speeds for the John Deere No. 55 above 45 feet per minute were likely to give less than 100 percent cell fill and that the cell fill increased as the plate speed was reduced. To make this information usable in terms of miles per hour and pounds of seed per acre Figure 2 shows how the data can be interpreted for use in the field.

Figures 3 and 4 show the performance and the interpretation of the data for the John Deere No. 66. Figures 5 and 6 show similar information for the International Harvester No. 40. These drills are all of the horizontal plate type and showed similar characteristics.

The three vertical plate planters showed more varied characteristics as illustrated by Figure 7 for the Cobley-Plantrol planter. Figure 8 shows the interpretation of the data for the Cobley planter in terms of miles per hour and pounds of seed per acre.

Since the Paul Milton planter has only one gear ratio Figure 9 shows both the cell fill characteristics and the miles per hour which may be used for its fixed seeding rate. The 7 to 9/64 seed used was too small for this planter but the decline in cell fill with increased plate speed is shown equally well.

Figures 10 and 11 are for the Rassmann planter and show quite clearly that the plate speed must be kept low to get good cell fill. The volume of the cell in this planter is the smallest of any tested and results in the comparatively lower cell fill at even low plate speeds.

Tests have not been made to determine whether the reduction in cell fill from 130 percent to 100 percent with increased plate speed is due to empty cells passing through the seed or each cell filling with only one seed. The corresponding reduction in seed damage would lead to the conclusion that the planter should be operated at a speed which would give very nearly 100 percent cell fill. Surely a planter should not be operated at a speed greatly in excess of that which will give very nearly 100 percent cell fill. Lower speeds with corresponding increases in cell fill would not be too harmful.

Table I Cell Fill and Seed Damage

Data given as averages of four ten-minute runs

at 2, 3, 4 & 5 inch seed levels respectively

Planter	Plate Speed Ft./ minute	Average percent cell fill	Average percent Seed Damage
John Deere No. 55	11.47	1.315	No data
	20.00	1.214	No data
	40.00	1.063	4.04
	60.00	.922	2.76
	80.00	.801	3.00
	100.00	.641	2.72
	140.00	.423	3.66
	180.00	.246	4.62
John Deere No. 66	11.45	1.231	3.39
	20.00	1.183	3.54
	40.00	1.082	2.88
	60.00	.979	1.93
	80.00	.848	1.58
	100.00	.685	1.84
	140.00	.466	2.35
	180.00	.268	3.94
International Harvester Company No. 40	10.00	1.220	3.84
	20.00	1.175	3.49
	40.00	1.082	3.36
	60.00	1.014	2.72
	80.00	.722	3.49
	100.00	.817	2.57
	140.00	.548	4.06
	180.00	.271	5.06
Cobley Plantrol	12.56	1.350	10.41
	20.00	1.347	10.24
	40.00	1.251	11.97
	60.00	1.306	11.19
	80.00	.995	10.66
	100.00	.869	13.59
	140.00	.794	20.44
	180.00	.642	26.11
Paul Milton	10.00	1.570	7.23
	20.00	1.501	6.90
	40.00	1.416	6.83
	60.00	1.227	5.52
	80.00	.950	5.29
	100.00	.653	5.75
	140.00	.381	5.72
	180.00	.270	5.90
Rassmann	12.15	1.159	5.48
	20.00	1.064	3.18
	40.00	.965	2.87
	60.00	.730	2.93
	80.00	.521	4.13
	100.00	.422	5.42
	140.00	.284	8.48
	180.00	.202	8.38

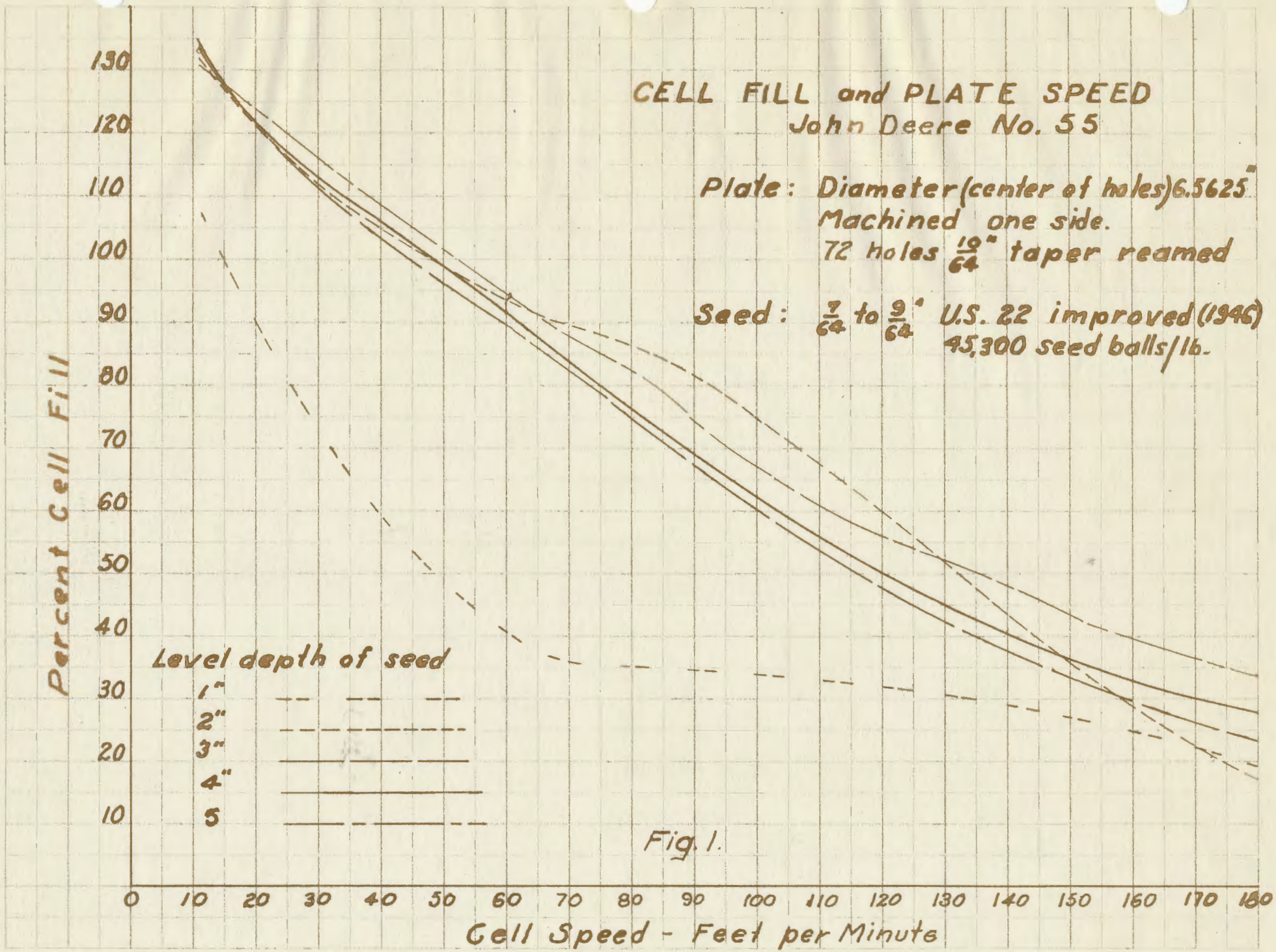
CELL FILL and PLATE SPEED
John Deere No. 55
Plate: Diameter (center of holes) 6.5625"
Machined one side.
72 holes 19/64" taper reamed
Seed: 7/64 to 9/64" U.S. 22 improved (1946)
45,300 seed balls/lb.
Level depth of seed
1"
2"
3"
4"
5
Percent Cell Fill
130
120
110
100
90
80
70
60
50
40
30
20
10
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180
Cell Speed - Feet per Minute

Fig. 1.

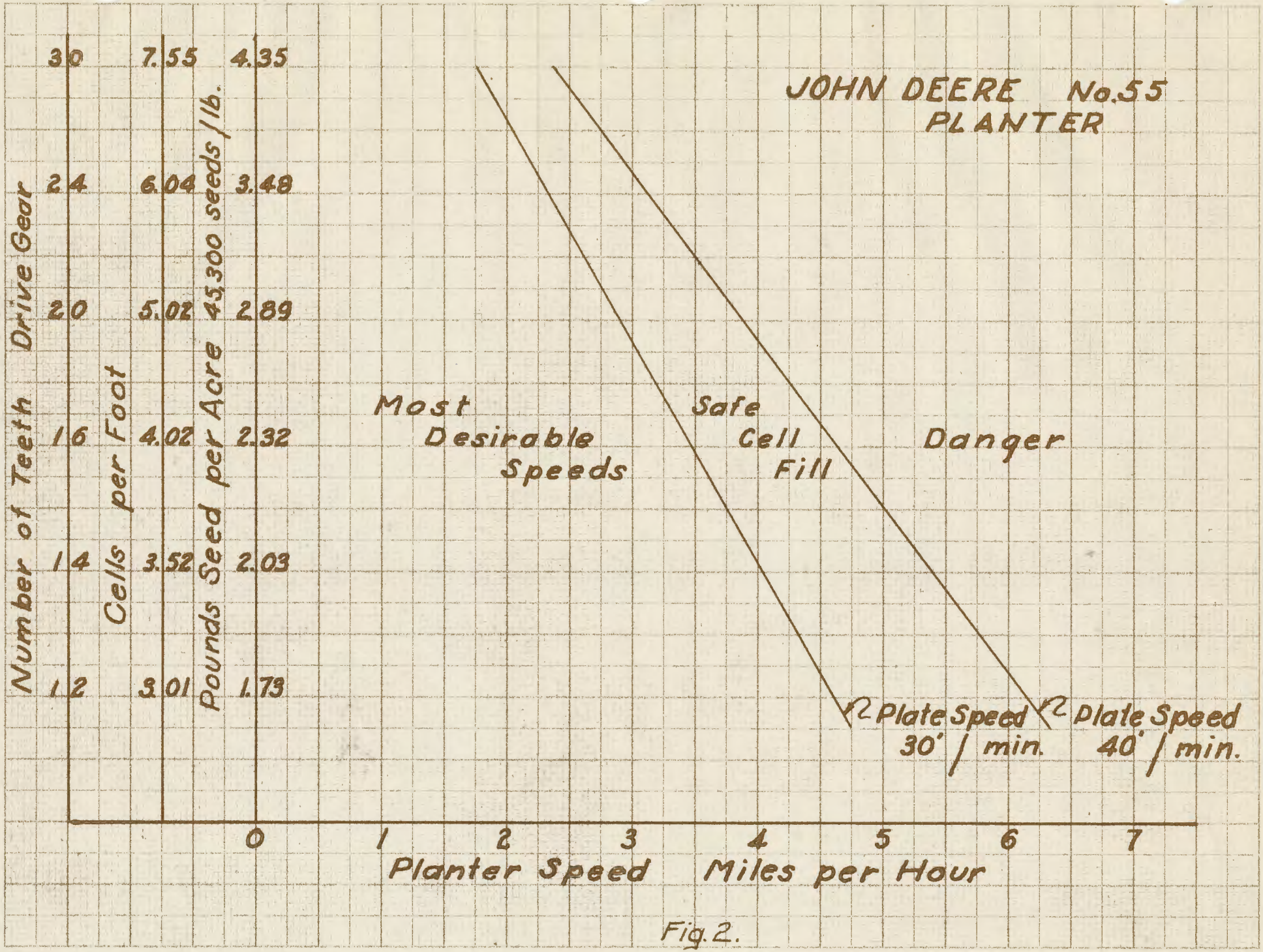

Fig. 2.

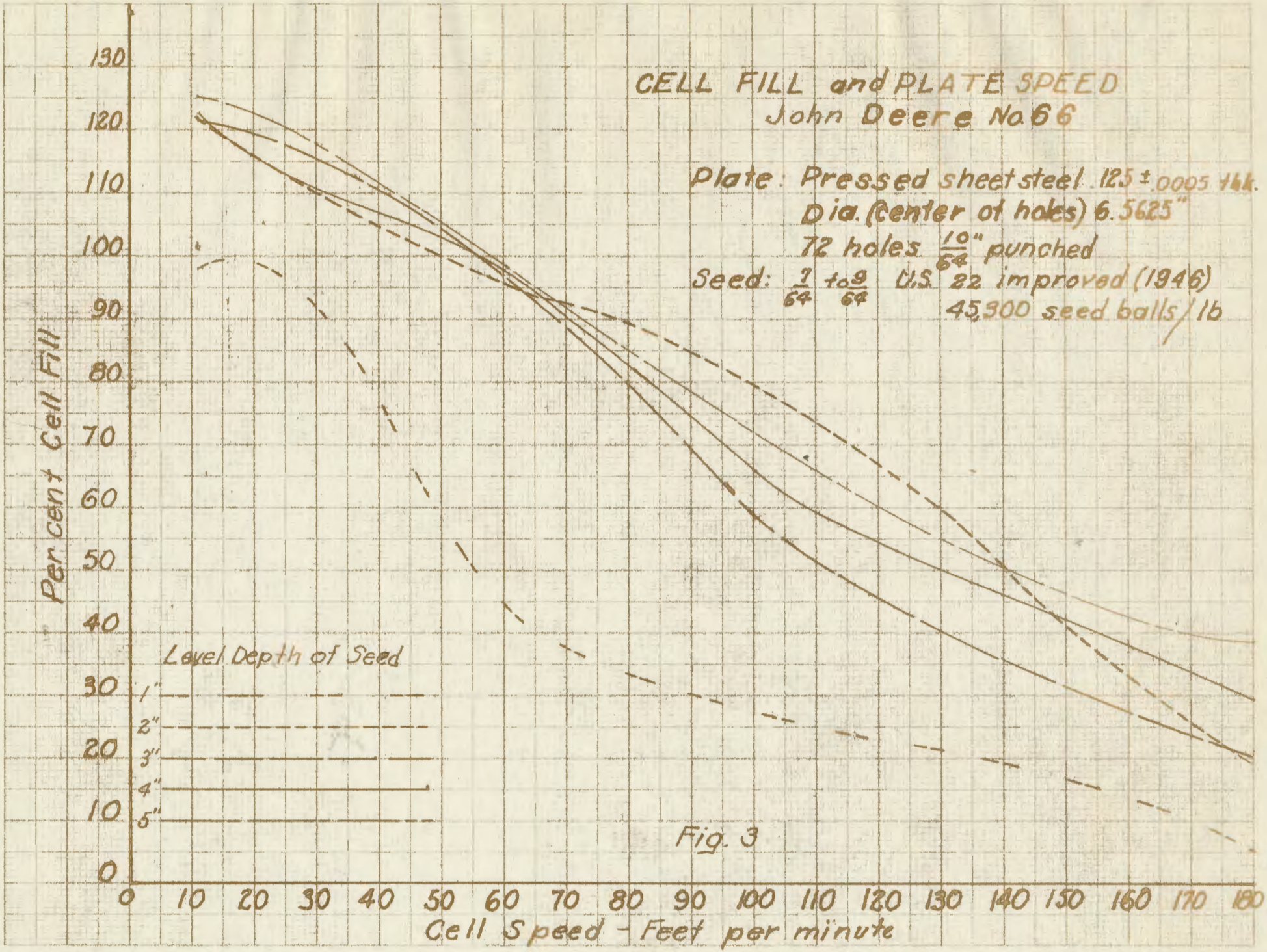
CELL FILL and PLATE SPEED
John Deere No. 66
Plate: Pressed sheet steel .125 ± .0005 thk.
Dia. (center of holes) 6.5625"
72 holes 10/64" punched
Seed: 7/64 to 9/64 U.S. 22 improved (1946)
45,300 seed balls / lb
Level Depth of Seed
1"
2"
3"
4"
5"
Per cent Cell Fill
Cell Speed - Feet per minute
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180

Fig. 3

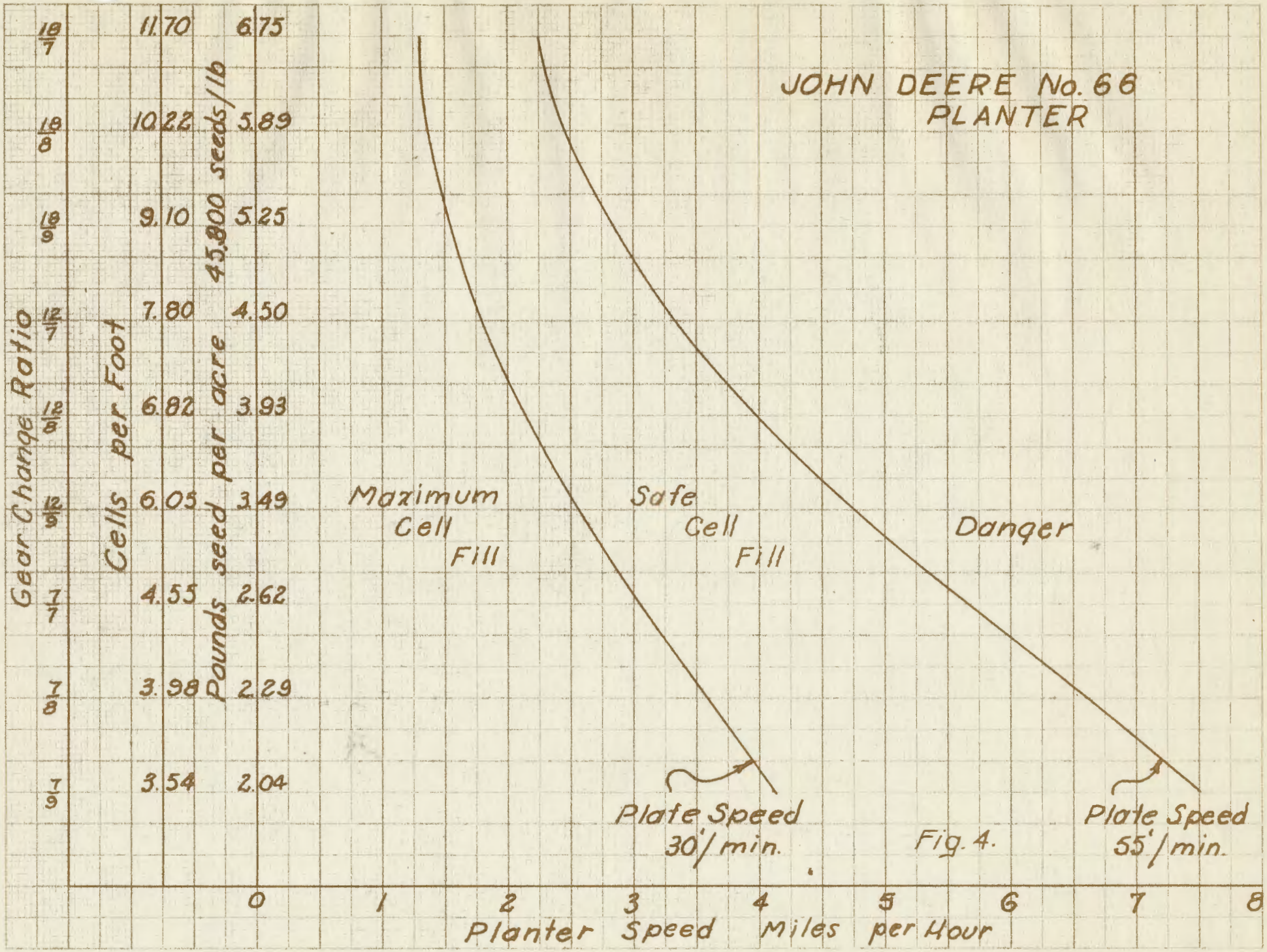
JOHN DEERE No. 66
PLANTER
Gear Change Ratio
Cells per Foot
Pounds seed per acre
45,800 seeds/lb
18/7 11.70 6.75
18/8 10.22 5.89
18/9 9.10 5.25
12/7 7.80 4.50
12/8 6.82 3.93
12/9 6.05 3.49
7/7 4.55 2.62
7/8 3.98 2.29
7/9 3.54 2.04
Maximum Cell Fill
Safe Cell Fill
Danger
Plate Speed 30'/min.
Plate Speed 55'/min.
0 1 2 3 4 5 6 7 8
Planter Speed Miles per Hour

Fig. 4.

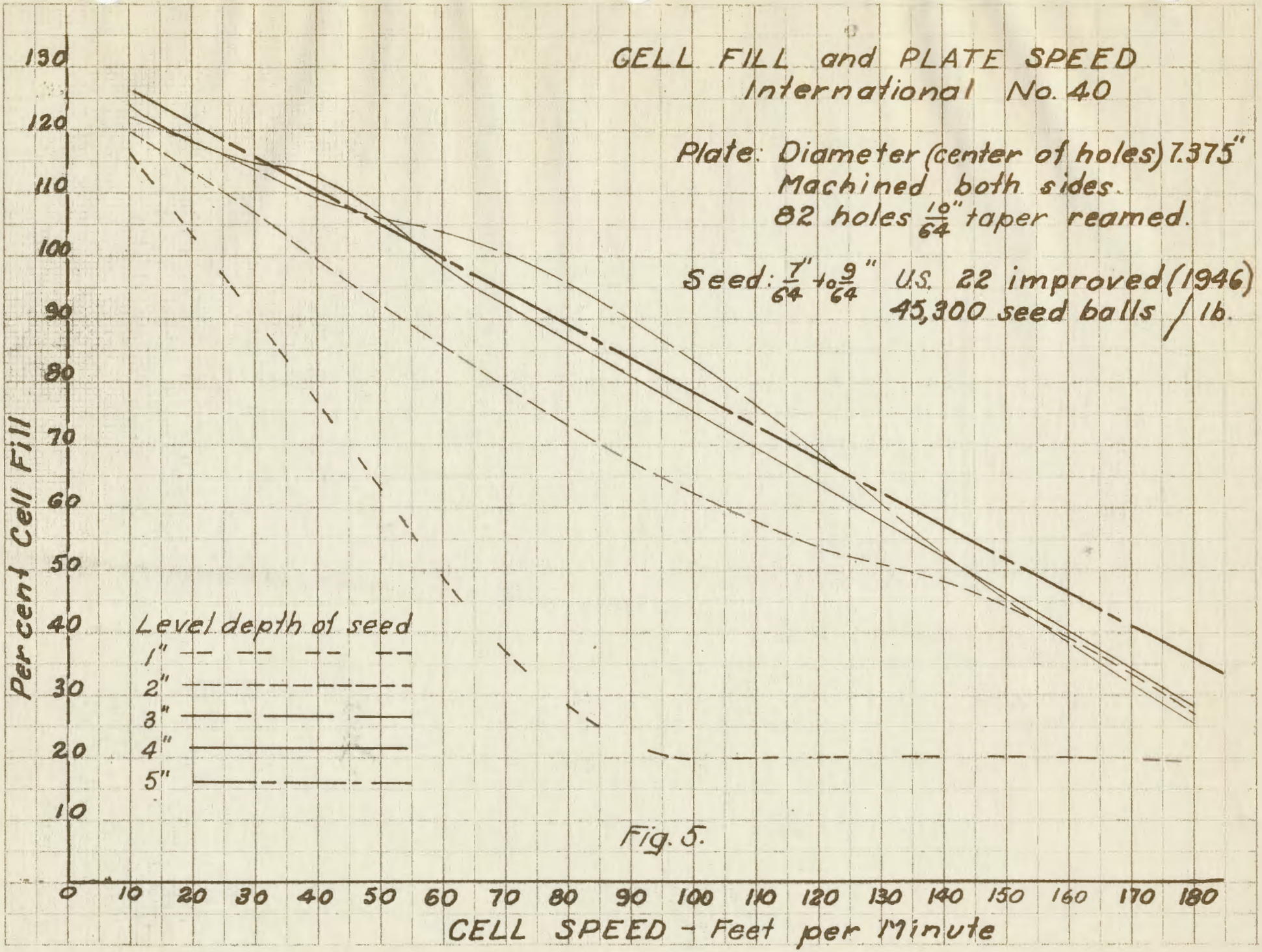

Fig. 5.

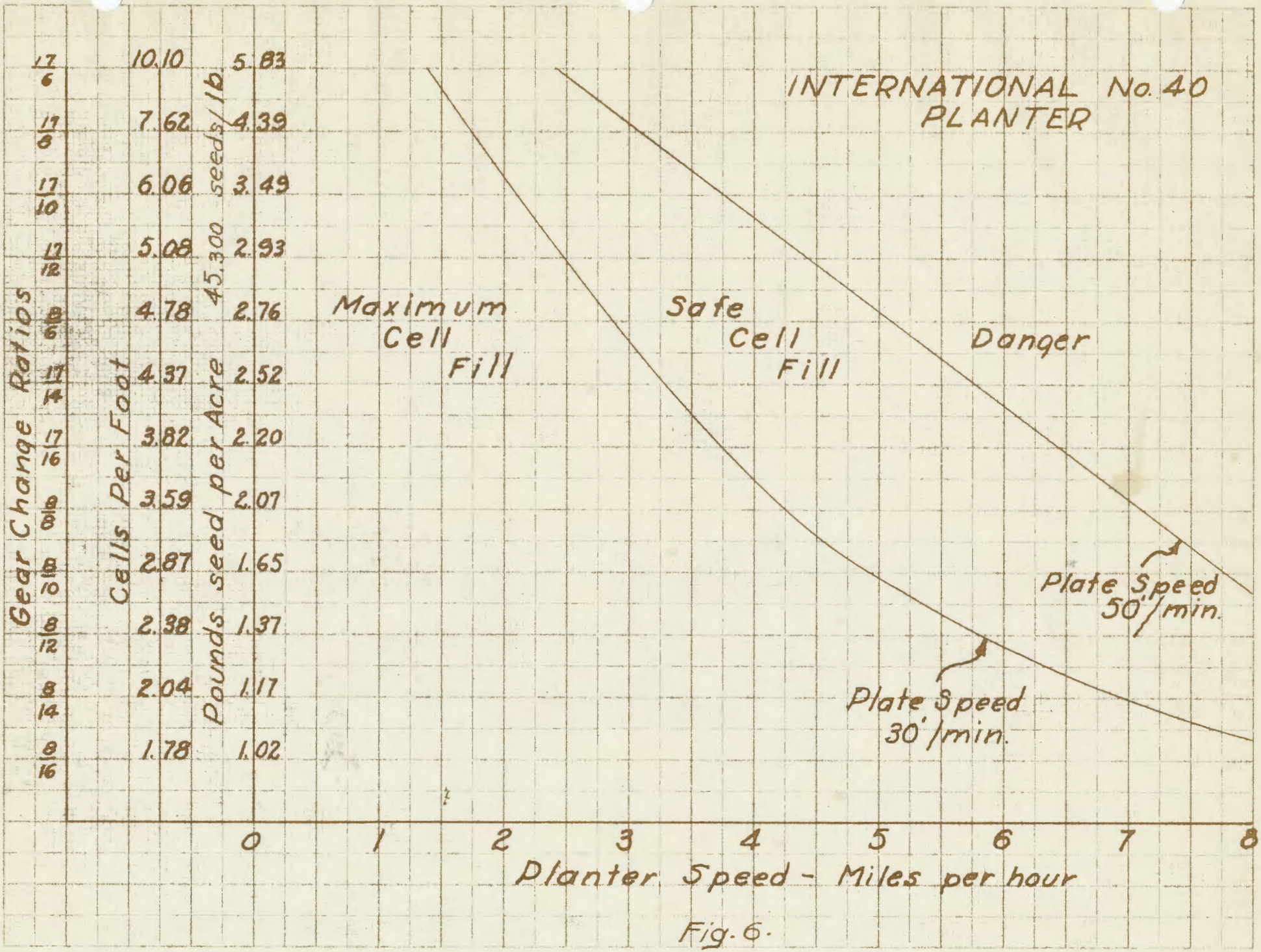

Fig. 6.

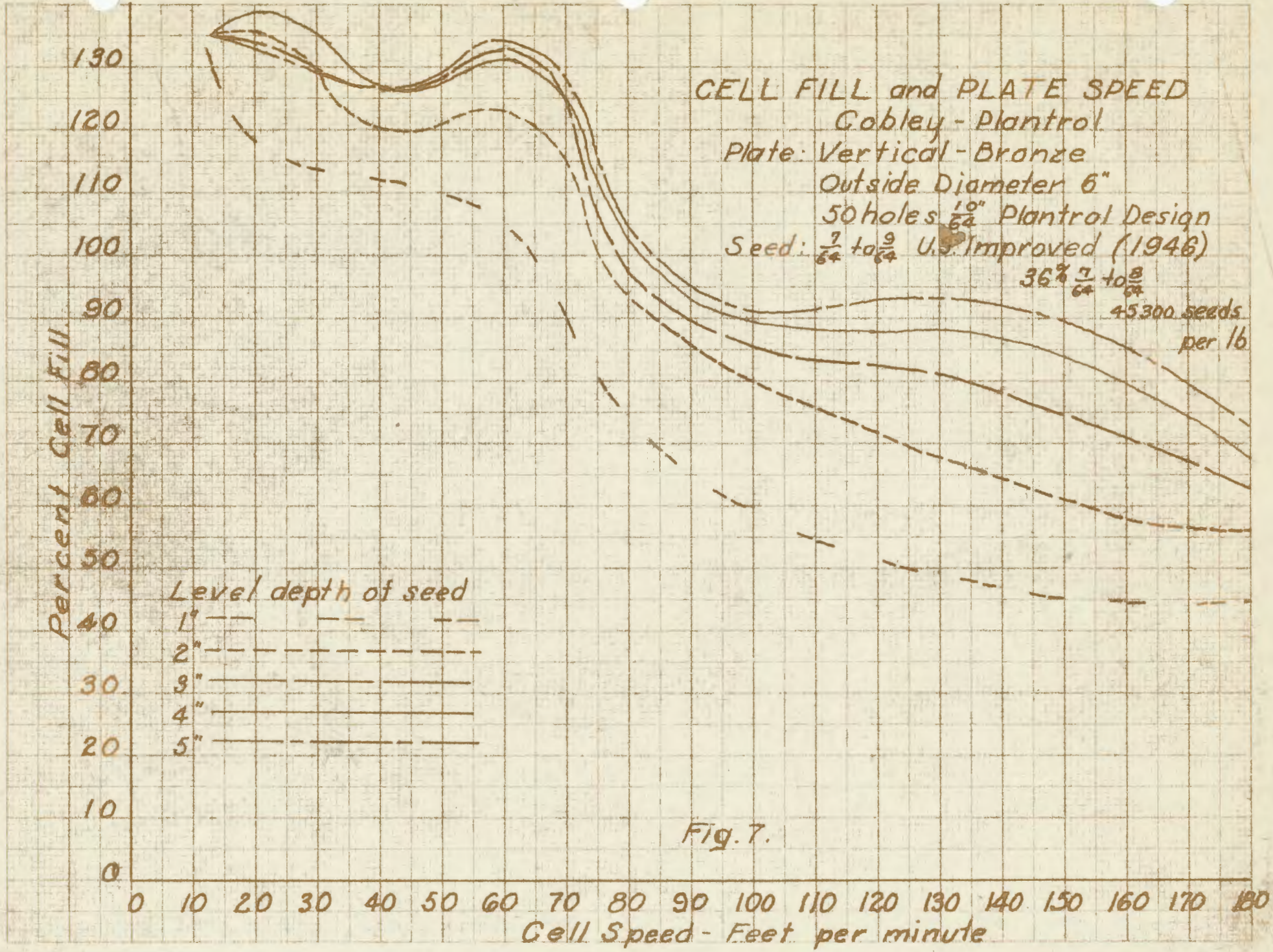
CELL FILL and PLATE SPEED
Cobley - Plantrol
Plate: Vertical - Bronze
Outside Diameter 6"
50 holes 10/64" Plantrol Design
Seed: 7/64 to 9/64 U.S. Improved (1946)
36% 7/64 to 8/64
45300 seeds per lb
Level depth of seed
1"
2"
3"
4"
5"
Percent Cell Fill
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180
Cell Speed - Feet per minute

Fig. 7.

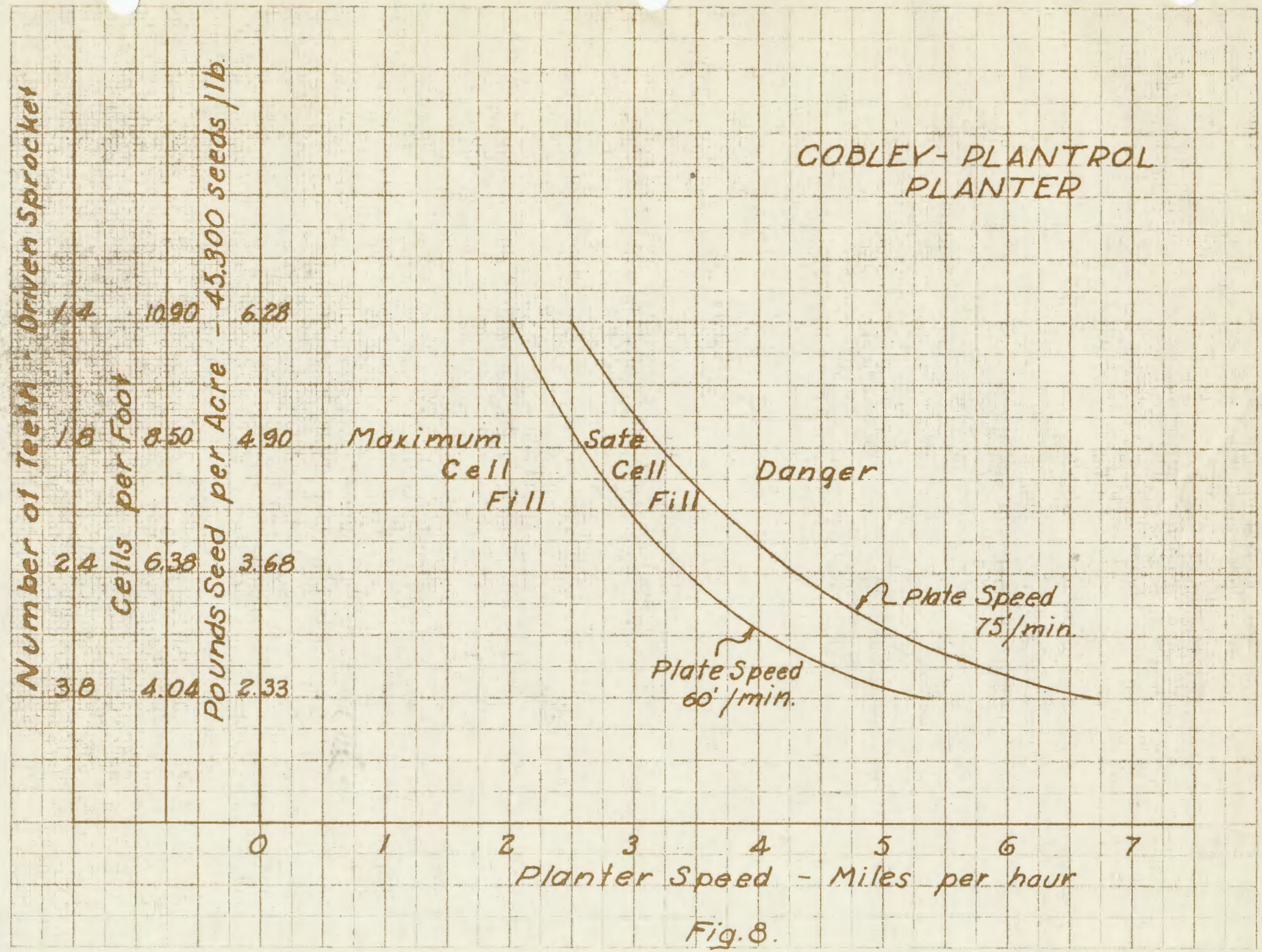
COBLEY - PLANTROL PLANTER
Number of Teeth - Driven Sprocket
Cells per Foot
Pounds Seed per Acre - 45,300 seeds / lb.
14 10.90 6.28
18 8.50 4.90
24 6.38 3.68
36 4.04 2.33
Maximum Cell Fill
Safe Cell Fill
Danger
Plate Speed 75'/min.
Plate Speed 60'/min.
0 1 2 3 4 5 6 7
Planter Speed - Miles per hour

Fig. 8.

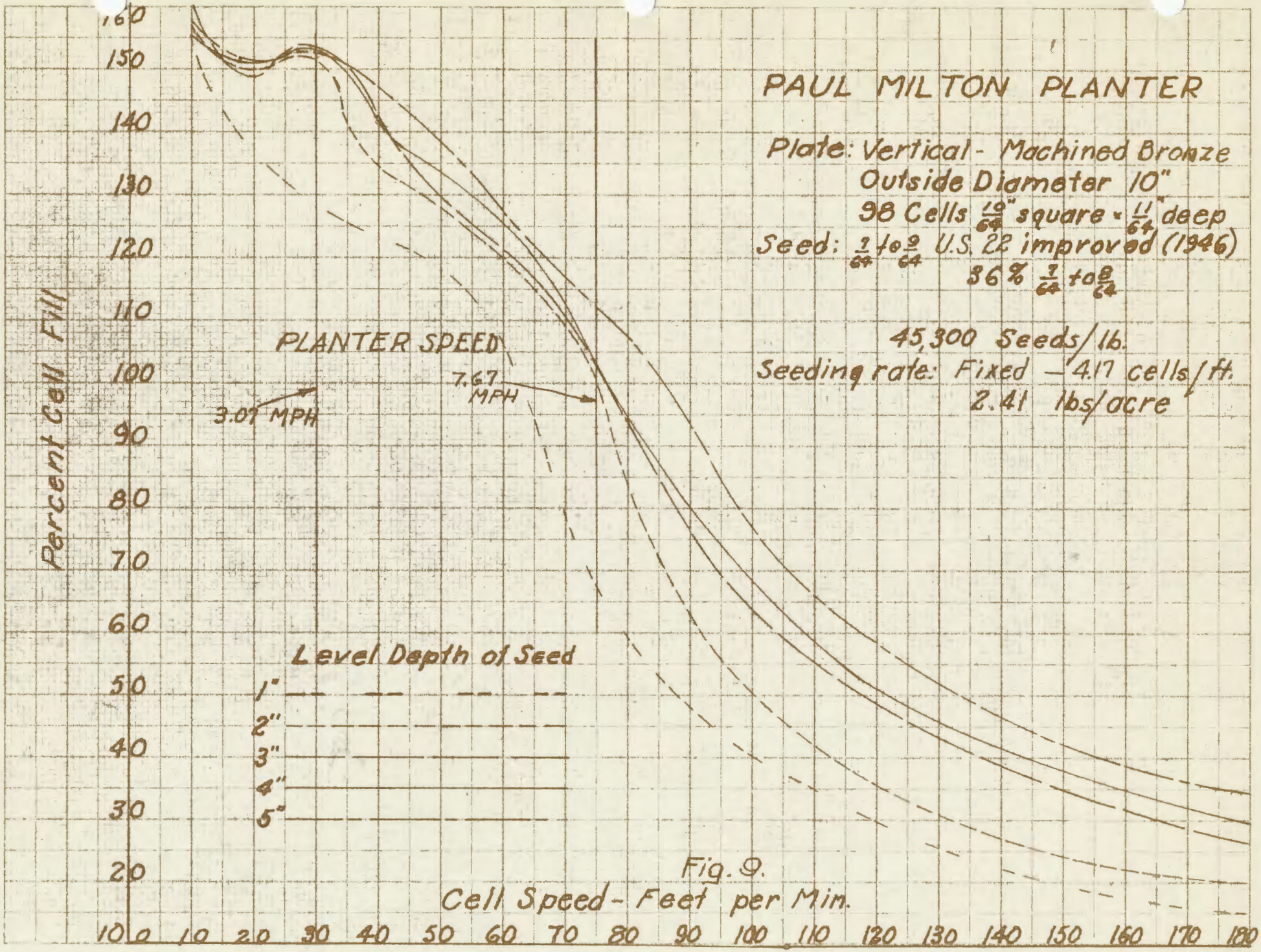

Fig. 9.

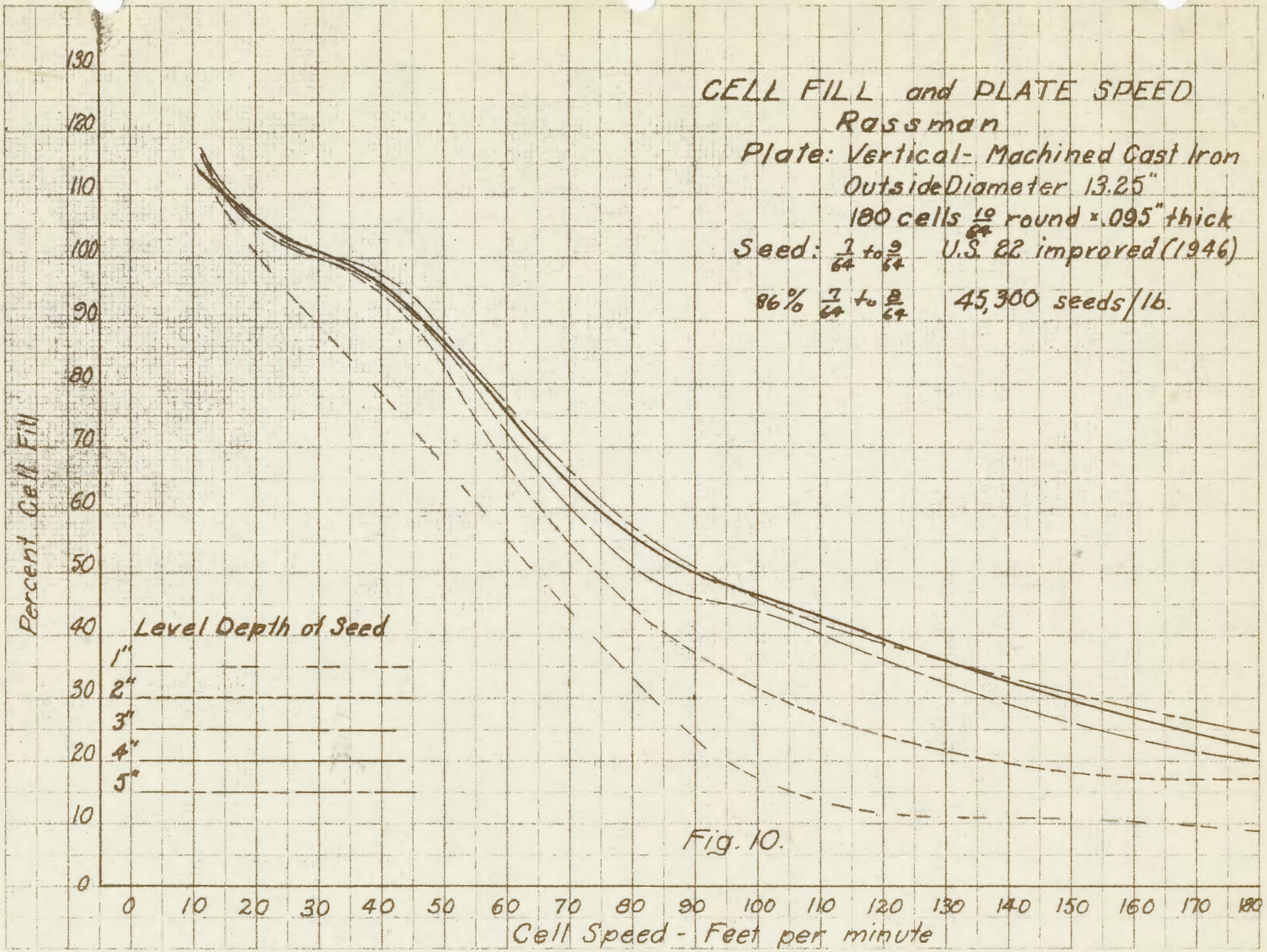
CELL FILL and PLATE SPEED
Rassman
Plate: Vertical- Machined Cast Iron
Outside Diameter 13.25"
180 cells 10/64 round x .095" thick
Seed: 7/64 to 9/64 U.S. 22 improved (1946)
86% 7/64 to 9/64 45,300 seeds/lb.
Percent Cell Fill
Level Depth of Seed
1"
2"
3"
4"
5"
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180
Cell Speed - Feet per minute

Fig. 10.

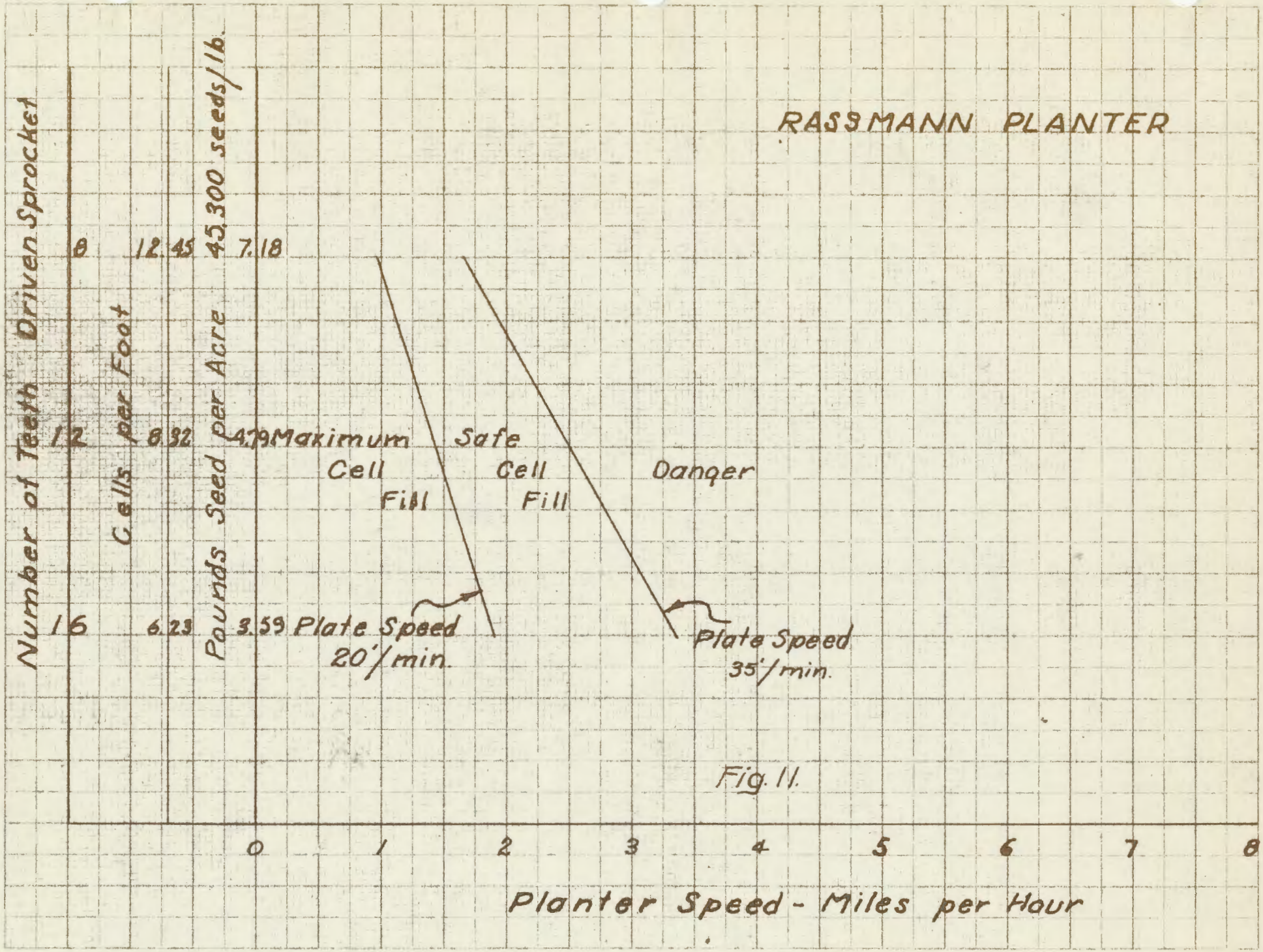

Fig. 11.