Calculating Swine Schedules - Pork Industry Handbook
Michigan State University Cooperative Extension Service
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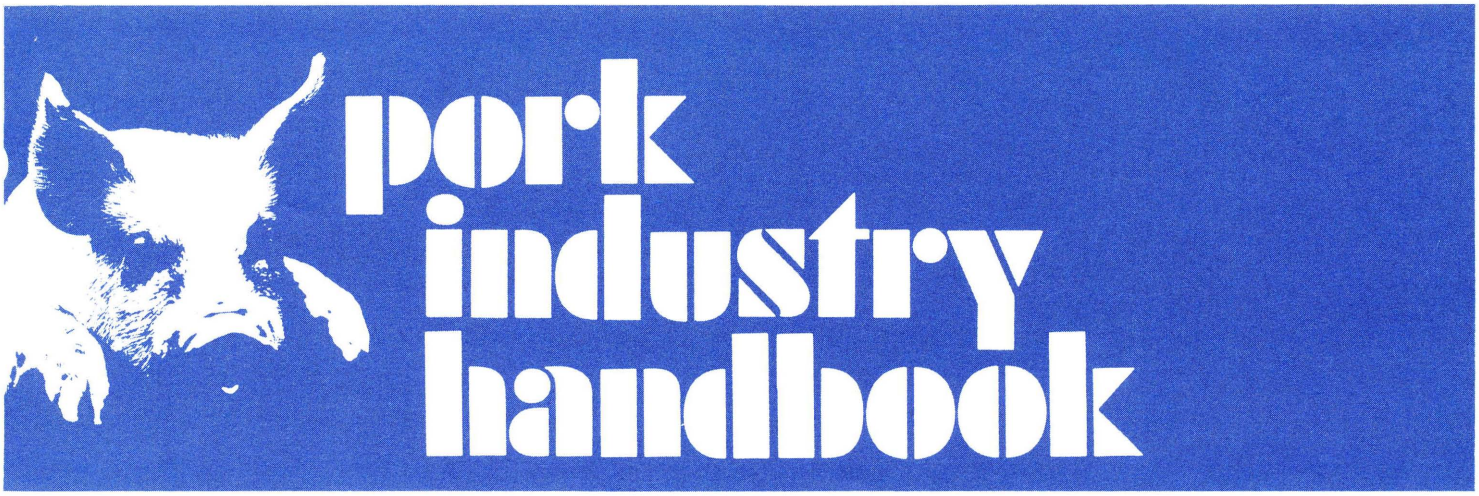

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Pork producers generally want an even flow of livestock through their facilities, high building occupancy without overcrowding, an all-in, all-out operation to improve sanitation and help break disease cycles. Scheduling less than maximum production typically results from herd health problems or seasonal labor shortages. Pressure for maximum production comes from the investment costs of facilities; i.e., expensive facilities must be used intensively to be economical.

To maximize facility use while keeping control of farrowing schedules, most producers divide their sow herds into groups and schedule the breeding and farrowing times within biological limitations. A schedule helps meet their production, labor, facility, and other management goals. This publication is intended to help producers calculate a swine schedule for their particular situation.

Principles of Swine Production

Understanding the basic principles of the sow's reproduction cycle and the growth rates of pigs is essential to developing a good schedule.

Farrowing Interval: The sow's biological cycle (the number of days between two successive farrowings of an individual sow) is the major constraint in a swine schedule. A portion of her time is spent in breeding, a portion in gestation, and a portion in farrowing. The gestation period is the most fixed of these values — about 16½ weeks plus or minus a day or so. The rule of thumb for swine gestation periods is 3 months, 3 weeks and 3 days. For our purposes, we will use a range of 113-116 days.

Breeding: The length of the breeding period (the time from weaning until mating) depends upon which estrous cycle the sows are bred. First heat breeding (breeding at the first estrus after weaning) is the most desirable. The first estrus normally begins about three days after weaning (with a typical range of 3-7 days). The second heat occurs about 3 weeks later (with a range of 22 to 30 days after weaning). Thus, sows bred on their second heat average about 26 days from weaning to breeding. The range in estrus occurrence becomes greater (by about 3 days) with the passage of each successive estrous cycle in which the sows are not bred and will be carried through the gestation period resulting in a wider range in birth times and weaning ages within a group.

To reduce the weight and age ranges of weaned pigs, producers must strive to minimize the time over which sows are bred and thereby the range over which pigs are farrowed. If sows are exposed to the boar from the first return to estrus (about 3 days after weaning) for 4 days (breeding time) and then removed, most reproductively efficient sows should have returned to estrus, bred, and settled. Sows that have not settled should be culled from the herd. This means faster turnover in the sow herd and might mean selling sows that farrowed a large, healthy litter last time. It requires discipline on the part of the manager. A lack of discipline, however, will result in degeneration of a scheduled system to continuous farrowing and the inability to maintain an all-in, all-out system. This is especially true of more intensive schedules. Production schedules with fewer than about 8 farrowings per year sometimes breed over a 10- to 14-day period. This gives a longer time to work bred gilts into the sow groups and decreases the management level needed at breeding time.

Conception rates are affected by seasonal factors, but these factors aren't well understood. Rates depend to

some extent on the geographical location of the farm (climate), on the type of facilities in use, and on management factors. For example, animals in an artificially heated and cooled environment will not be affected to the extent of animals housed in outside lots and uninsulated shelters. However, seasonal conception rate differences occur in swine regardless of temperature effects. They can even be different from herd to herd in similar locations.

If conception rates are significantly lower during certain times of the year, additional sows must be bred to ensure that farrowing crates are kept full later in the year. For example, if herd records show that a 60% conception rate typically occurs during July breedings, 34 females (20 ÷ 0.6) must be bred in order to fill a 20-sow farrowing house 113 days later. Since it is uneconomical to carry a sow to the second heat period if she does not conceive, gilt replacement numbers must be determined in advance and added to the herd at the desired breeding time. See PIH-89, *Managing the Gilt Pool* for more information.

Weaning age: The typical weaning age used in the U.S. is about 5 weeks, with a range of 2 to 8 weeks. This is the one variable that the producer can control (within practical limits) and that directly affects the rest of the schedule. For example, the calculated breeding period can be lengthened by lowering the minimum desired weaning age while leaving the maximum desired weaning age constant. Certainly, it is not surprising that a longer breeding period would result in a wider range of weaning ages (see the attached worksheet). Likewise, the interval between successive farrowings (IBF) is lengthened by increasing the maximum weaning age or shortened by decreasing the maximum weaning age.

Animal Growth Rates: Typical weight and age ranges for nursery and growing-finishing animals are shown in Table 1.

Table 1. Typical swine growth ranges.

Production stage	Age range (weeks)	Weight (lb)
Farrowing	0-8	3-40
Nursery	3-12	10-100
Growing	9-18	60-150
Finishing	18-30	150-230

Ages of market hogs range from 22 to 30 weeks with an average of about 28 weeks in inside facilities and a week or two less if hogs are finished during summer months in outside lots.

The Group Concept

The actual time that swine are in each production stage depends more on IBF than on any other single factor since most producers move animals in groups after they leave the farrowing area. Furthermore, they typically move all groups at about the same time, except for perhaps a short period when a room might be empty for cleaning or for equipment repair. For example, a group might be sold from finishing, a new group moved there from growing, and the space in growing taken up by a new group moved in from the nursery, and so on. Therefore all buildings in the production process should be sized to hold an even number of animal groups, with the group size being equal to the number of pigs weaned from one group of sows. For example, the nursery should be sized to hold either one or two groups, not 1½ groups. Knowing that a new group will need to enter the production process at the end of each IBF, all the necessary information is available to determine the schedule as soon as the IBF is known.

Worksheet for computing a swine production schedule.

Example Situation: A farmer wishes to construct a new farrow-to-finish unit. He is planning to use a one-room, 20-crate farrowing house. He hopes to wean 8 pigs per litter and finish animals in 180 days. Because of other demands on labor, he needs at least 10 days for cleanup in farrowing and will pen breed at first heat. He is willing to use enough boars to be able to use each boar only once a day. His goal is a conception rate of 80%, although he expects this to drop to 67% during summer months because of hot weather breeding problems. Desired minimum and maximum weaning ages are 29 days and 37 days, respectively.

NOTE: All calculations are done in days.

	Example	Your values
1. Farrowing facilities description		
a. Number of rooms (farrowing or sow-pig nursery):	*1*	_____
b. Number of crates per room:	*20*	_____
c. Minimum building open time needed between farrowings:	*10 days*	_____
2. Weaning information		
a. Desired minimum age:	*29 days*	_____
b. Desired maximum age (at least 7 days greater than minimum age for first heat breeding, 11 days greater for second heat breeding):	*37 days*	_____
c. Average number weaned per litter:	*8*	_____
3. Breeding information		
a. Breed on first or second heat?	*1st*	_____
b. Minimum time required after weaning for sows to mate (3 days for first heat and 22 days for second heat breeding):	*3 days*	_____
c. Number of services per boar per day during mating period:	*1*	_____
d. Average conception rate, %:	*80%*	_____
e. Minimum expected conception rate, %:	*67%*	_____

4. Interval between (successive) farrowings estimate		
a. Farrowing span: Step 2.b - Step 2.a (37-29)	*8 days*	_____
b. Estimated IBF: Step 1.c + Step 2.b (10+37)	*47 days*	_____
5. Number of sow groups and actual IBF		
a. Weaning to weaning interval: Step 3.b + Step 2.b + min. gestation period (3+37+113)	*153 days*	_____
b. Total number of sow groups: (Step 5.a x Step 1.a)÷Step 4.b (((153x1)÷47)=3.1) Truncate result if not a whole number	*3*	_____
c. Actual IBF: (Step 5.a x Step 1.a) ÷ Step 5.b ((153x1)÷3=51) Round off result if not a whole number	*51 days*	_____
d. Number of sow groups per room: Step 5.b ÷ Step 1.a (3÷1)	*3*	_____
e. Actual open period available between farrowings: Step 5.c - Step 2.b (51-37)	*14 days*	_____
f. Age difference between each pig group (time from start of one farrowing to start of next): Step 5.c÷Step 1.a (51÷1)	*51 days*	_____
6. Breeding herd requirements		
a. Average number of sows in herd:* (Step 5.b x Step 1.b x 100)÷Step 3.d ((3x20x100)÷80)	*75*	_____
b. Breeding span: Step 4.a - 3 (8-3)†	*5 days*	_____
c. Total number of services per boar per breeding period: Step 3.c x Step 6.b (1x5)	*5*	_____
d. Sow capacity in breeding: Step 1.b x 100 ÷ Step 3.e (round answer off to next highest whole number) (20x100÷67)	*30*	_____
e. Number of boars required: [Step 6.d x number of services per estrus (2) ÷ Step 6.c (round value off to next highest number, e.g., use 9 instead of 8.57) (30 x 2)÷5	*12*	_____
f. Time period after weaning by which a sow group must be bred. For first heat, use 3 days to reach estrus after weaning + Step 6.b. For second heat breeding, use 22 days to reach estrus + Step 6.b (3+5)	*8 days*	_____
7. Pig production		
a. Potential number of litters per sow per year possible: 365 days per year ÷ Step 5.a (365÷153)	*2.38*	_____
b. Average number of litters per sow per year: (Step 7.a x Step 1.b x Step 5.b) ÷ Step 6.a ((2.38x20x3)÷75)	*1.90*	_____
c. Maximum number of litters per year for entire herd: Step 1.b x Step 7.a x Step 5.b (Truncate result if not whole number) (20x2.38x3)	*143*	_____
d. Maximum number of pigs produced per year: (365÷Step 5.f) x Step 1.b x Step 2.c ((365÷51) x 20 x 8)	*1145*	_____
e. Average age of pig at market (days):	*180 days*	_____
f. Number of pigs per group: Step 1.b x Step 2.c (20 x 8)	*160*	_____
g. Number of pig groups from birth to market:‡ Step 7.e ÷ Step 5.f (round off result to next highest number, i.e., use 4 instead of 3.53) (180÷51)	*4*	_____
h. Upper age bracket of youngest pig group: The smaller of Step 5.f or Step 2.b	*37*	_____
i. Age bracket of next oldest pig group: [Step 7.h] to [Step 7.h + Step 5.f] (37 to 37+51)	*37-88*	_____
j. Age ranges for rest of pig groups: [88] to [88 + Step 5.f] [139] to [139 + Step 5.f] (Continue calculation to maximum age of Step 7.e)	*88-139* *139-190*	_____

* By pregnancy checking and culling open sows, not all sow groups need to be multiplied by 1.2 (assuming 80% conception rate). This will decrease the total number of sows in the herd and decrease the capacity needed in gestation accordingly.

† Breeding span can be adjusted by modifying minimum weaning age, without significantly affecting other scheduling variables (e.g., lowering minimum weaning age by one day lengthens farrowing span and breeding span by one day).

‡ This value must be rounded off to the next highest number to compute building capacity needed. Notice, however, that higher fractions give a better building utilization than lower fractions; 3.9 would be better than 3.5, for example, since space for one group of pigs would be empty one-half the time with 3.5 groups.

Numerical Solution

The limitations of a sow's biological cycle plus swine growth information can be reduced to a set of equations. This allows a producer to calculate an accurate schedule for his operation and to obtain information about the performance of that schedule. This is ideal for modern production-intensive systems and lends itself to computer solution, using a fairly simple program or spreadsheet.

The calculations work especially well for multiple room farrowing operations. A primary benefit of a worksheet solution is the ability to quickly calculate how well various schedules perform. Example schedules for five common systems, shown in Tables 2a through 2e, were calculated using the attached worksheet. Figure 1 graphically represents the information from the first example in Table 2a. A second blank schedule chart is provided for the reader's use in Figure 2.

Table 3 is a summary of building capacities for various schedules. It is based on 10-crate farrowing rooms, so that capacities can easily be scaled up or down to fit the size of your operation. This summary is not as useful for day to day planning as the schedules shown in Tables 2a through 2e but is very useful for determining facility capacities and

should be of interest to farm builders and to producers considering expansion.

The procedure for calculations with the worksheet is as follows: The time that sow groups occupy farrowing is computed, and the desired open time is then adjusted to resolve any conflicts in space usage. These calculations begin with the minimum open period that the producer feels is needed between sow groups and the desired maximum weaning age. These values are used to estimate the IBF. This estimated interval is then used to compute the number of sow groups. If the number is not whole, it is truncated (it would not make sense to have 3.9 sow groups, for example). Using the new sow group number, the interval is then recomputed. In effect, the worksheet accounts for the sow's biological needs and then adjusts the building schedule accordingly by varying the cleanup period. The period designated as open is really just a time when the farrowing room does not have sows in the process of farrowing or nursing. A portion of this time might be when sows are present before farrowing as well as when the building is being cleaned after weaning. Also, no pig mortality or gilts removed for breeding are included in the calculations.

Summary

The benefits of scheduling are well documented. Modern pork producers must use a disciplined method of controlling animal production and movement through expensive facilities.

Scheduling of single or multiple farrowing room systems can be done quickly and easily using the numerical solution outlined here. Furthermore, the calculations lend themselves readily to development of a computer program or spreadsheet that allows the producer to evaluate a wide range of schedules.

Table 2a. Schedule for 1 room, 14 days open, 3 groups of sows, farrow every 51 days.

SWINE SCHEDULING EXAMPLE #1 (All table values are in days)									
Group*	Enter farrowing	Begin farrowing**	Wean†	Breeding		Enter			Begin marketing‡
				Begin	End	Nursery	Growing	Finishing	
A_1	1	5	42	45	49	42	93	144	185
B_1	52	56	93	96	100	93	144	195	236
C_1	103	107	144	147	151	144	195	246	287
A_2	154	158	195	198	202	195	246	297	338
B_2	205	209	246	249	253	246	297	348	389
C_2	256	260	297	300	304	297	348	399	440
A_3	307	311	348	351	355	348	399	450	491
B_3	358	362	399	402	406	399	450	501	542
C_3	409	413	450	453	457	450	501	552	593

* This value refers to the sow group and to the pigs produced by that sow group. For example, B_3 would stand for the third farrowing of the second sow group.

** The cleanup or open period of 14 days is divided between 4 days in the building when sows are present before farrowing begins and 10 days after weaning when the building is empty. (Note that once the top row is determined, the rest of the table is easily computed by adding multiples of the IBF of 51 days).

† The maximum weaning age will be 37 days (42 minus 5 days open) and the minimum will be 29 days (37 minus 3 days to return to heat minus 5 days (day 45 through day 49) to mate).

‡ The first animals will be ready for market at 180 days of age. Since farrowing began on day 5, this will be day 185. This schedule requires building space for 1 pig group in nursery, 1 group in growing, and 1 group in finishing.

Table 2b. Schedule for 1 room, 5 days open, 4 groups of sows, farrow every 37 days.

SWINE SCHEDULING EXAMPLE #2 (All table values are in days)									
Group	Farrowing		Wean*	Breeding		Enter			Begin marketing†
	Enter	Begin		Begin	End	Nursery	Growing	Finishing	
A_1	1	3	35	38	41	35	72	109	183
B_1	38	40	72	75	78	72	109	146	220
C_1	75	77	109	112	115	109	146	183	257
D_1	112	114	146	149	152	146	183	220	294
A_2	149	151	183	186	189	183	220	257	331
B_2	186	188	220	223	226	220	257	294	368
C_2	223	225	257	260	263	257	294	331	405
D_2	260	262	294	297	300	294	331	368	442
A_3	297	299	331	334	337	331	368	405	479
B_3	334	336	368	371	374	368	405	442	516
C_3	371	373	405	408	411	405	442	479	553

* The maximum weaning age will be 32 days (35 minus 3 days open), and the minimum will be 25 days (32 minus 3 days to return to heat minus 4 days for the group to mate).

† This schedule requires building space for 1 pig group in nursery, 1 group in growing, and 2 groups in finishing.

Table 2c. Schedule for 2 rooms, 11 days open, 7 groups of sows, farrow every 21 days.

SWINE SCHEDULING EXAMPLE #3 (All table values are in days)											
Group	Enter farrowing house 1*	2	Begin farrowing	Wean	Breeding Begin	End	Enter nursery 1	2	Enter Growing	Finishing	Begin marketing†
A_1	1		5	36	39	44	36		78	120	185
B_1		22	26	57	60	65		57	99	141	206
C_1	43		47	78	81	86	78		120	162	227
D_1		64	68	99	102	107		99	141	183	248
E_1	85		89	120	123	128	120		162	204	269
F_1		106	110	141	144	149		141	183	225	290
G_1	127		131	162	165	170	162		204	246	311
A_2		148	152	183	186	191		183	225	267	332
B_2	169		173	204	207	212	204		246	288	353
C_2		190	194	225	228	233		225	267	309	374
D_2	211		215	246	249	254	246		288	330	395
E_2		232	236	267	270	275		267	309	351	416
F_2	253		257	288	291	296	288		330	372	437
G_2		274	278	309	312	317		309	351	392	458
A_3	295		299	330	333	338	330		372	414	479
B_3		316	320	351	354	359		351	393	435	500
C_3	337		341	372	375	380	372		414	456	521
D_3		358	362	393	396	401		393	435	477	542
E_3	379		383	414	417	422	414		456	498	563

* There are a total of 11 days open between farrowings (4 days when sows are in the building before farrowing begins and 7 days (43 minus 36) when the building is empty).

† This schedule requires building space for 2 groups in nursery (in two rooms), 2 groups in growing, and 3 groups in finishing (assumes pigs are sold at 178 days of age instead of 180). This means selling by the 183rd day in time to accommodate the next group coming from the growing unit.

Table 2d. Schedule for 3 rooms, 4 days open, 11 groups of sows, farrow every 14 days.

SWINE SCHEDULING EXAMPLE #4 (All table values are in days)													
Group	Enter farrowing house 1	2	3	Begin farrowing	Wean	Breeding Begin	End	Enter nursery 1	2	3	Enter Growing	Finishing	Begin marketing*
A_1	1			3	41	44	47	41			83	125	183
B_1		15		17	55	58	61		55		97	139	197
C_1			29	31	69	72	75			69	111	153	211
D_1	43			45	83	86	89	83			125	167	225
E_1		57		59	97	100	103		97		139	181	239
F_1			71	73	111	114	117			111	153	195	253
G_1	85			87	125	128	131	125			167	209	267
H_1		99		101	139	142	145		139		181	223	281
I_1			113	115	153	156	159			153	195	237	295
J_1	127			129	167	170	173	167			209	251	309
K_1		141		143	181	184	187		181		223	265	323
A_2			155	157	195	198	201			195	237	279	337
B_2	169			171	209	212	215	209			251	293	351
C_2		183		185	223	226	229		223		265	307	365
D_2			197	199	237	240	243			237	279	321	379
E_2	211			213	251	254	257	251			293	335	393
F_2		225		227	265	268	271		265		307	349	407
G_2			239	241	279	282	285			279	321	363	421
H_2	253			255	293	296	299	293			335	377	435
I_2		267		269	307	310	313		307		349	391	449
J_2			281	283	321	324	327			321	363	405	463
K_2	295			297	335	338	341	335			377	419	477
A_3		309		311	349	352	355		349		391	433	491

* This schedule requires building space for 3 groups in nursery (in three separate rooms), 3 groups in growing, and 4 groups in finishing (5 unless pigs are sold at 178 days of age to accommodate the group coming from the growing unit on the 181st day.

Table 2e. Schedule for 5 rooms, 4 days open, 21 groups of sows, farrow every 7 days.

SWINE SCHEDULING EXAMPLE #5 (All table values are in days)																
	Enter farrowing house					Begin		Breeding		Enter nursery				Enter		Begin
Group	1	2	3	4	5	farrowing	Wean	Begin	End	1	2	3	4	Growing	Finishing	marketing*
A_1	1					3	34	37	40	34				62	125	183
B_1		8				10	41	44	47		41			69	132	190
C_1			15			17	48	51	54			48		76	139	197
D_1				22		24	55	58	61				55	83	146	204
E_1					29	31	62	65	68	62				90	153	211
F_1	36					38	69	72	75		69			97	160	218
G_1		43				45	76	79	82			76		104	167	225
H_1			50			52	83	86	89				83	111	174	232
I_1				57		59	90	93	96	90				118	181	239
J_1					64	66	97	100	103		97			125	188	246
K_1	71					73	104	107	110			104		132	195	253
L_1		78				80	111	114	117				111	139	202	260
M_1			85			87	118	121	124	118				146	209	267
N_1				92		94	125	129	131		125			153	216	274
O_1					99	101	132	135	138			132		160	223	281
P_1	106					108	139	142	145				139	167	230	288
Q_1		113				115	146	149	152	146				174	237	295
R_1			120			122	153	156	159		153			181	244	302
S_1				127		129	160	163	166			160		188	251	309
T_1					134	136	167	170	173				167	195	258	316
U_1	141					143	174	177	180	174				202	265	323
A_2		148				150	181	184	187		181			209	272	330
B_2			155			157	188	191	194			188		216	279	337

* This schedule requires building space for 3 groups in each nursery room, 9 groups in growing, and 8 groups in finishing (if pigs are sold at 178 days of age, 9 groups otherwise).

Table 3. Summary design table of building capacities needed per 10 sows farrowed per period (80% average conception rate).*

	# of crates needed in farrowing	# of sow groups	Total # of sows	# of sows in gesta-tion	# of sows in post farrow.	# of boars	Interval between farrowing (days)	Farrow. per yr.	# of sows & litters in sow-pig nursery	Number of pigs in			# pigs mkt./ Year
										Nursery	Growing	Finish.	
1.	10	3	39	24	15	2	56	6X	--	80	--	160	520
2.	10	3	39	24	15	3	51	7X 1st heat	--	80	80	80	575
3.	10	4	51	36	15	3	42	8X	--	80	80	160	695
4.	10	4	51	36	15	5	37	10X 1st heat	5	80	160	180	830
5.	10	5	63	48	15	5	28	12X 1st heat	10	80	160	80	1040
6.	20 (in 2 rooms)	7	85	60	15	3	21	17X	--	160	160	240	1390
7.	30 (in 3 rooms)	11	131	96	15	4	14	26X	--	240	240	320	2085
8.	50 (in 5 rooms)	21	237	182	15	4	7	Weekly	--	320	640	800	4170

* A producer wants to farrow 7 times a year in a 24-crate farrowing house. How big must his other facilities be, and how many finishing hogs can he produce per year?

Go to row 2 in the table and use a multiplier of 24 ÷ 10 sow capacity = 2.4. At 7 farrowings per year, there should be room for 25 x 2.4 = 60 sows in gestation, 15 x 2.4 = 36 sows and 3 x 2.4 = 8 boars in breeding, and 24 crates in farrowing for a total sow herd of 37 x 2.4 = about 89 sows. No sow-pig nursery is needed, and the pig nursery should hold 80 x 2.4 = 192 pigs. The growing area capacity should also be 80 x 2.4 = 192, and the finishing building should hold 80 x 2.4 = 192. The producer can market 575 x 2.4 = 1,380 hogs per year.

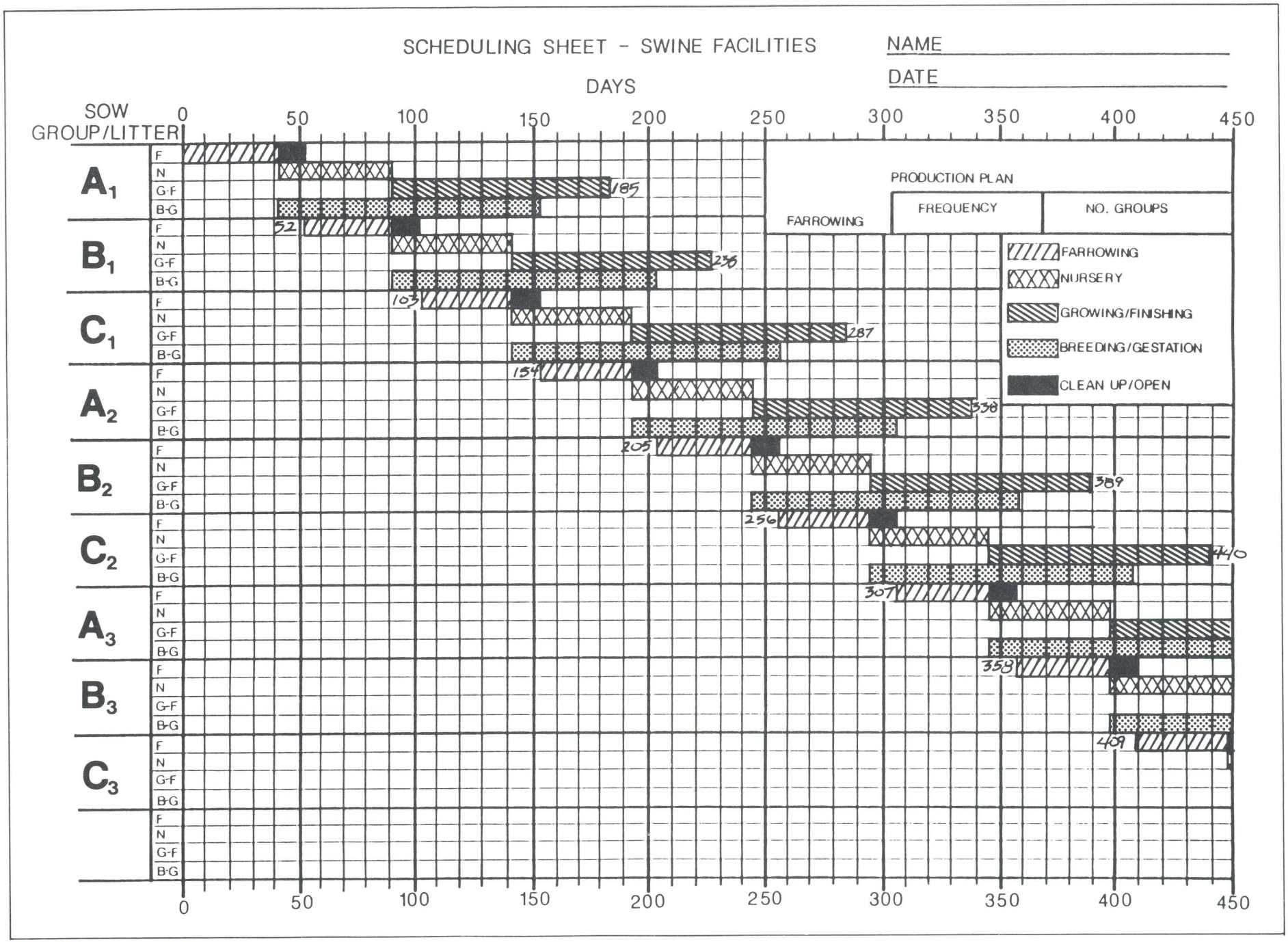

Figure 1. Example from Table 2a, represented graphically.

5:88-3M-New-SDC/RP-Price: 35¢

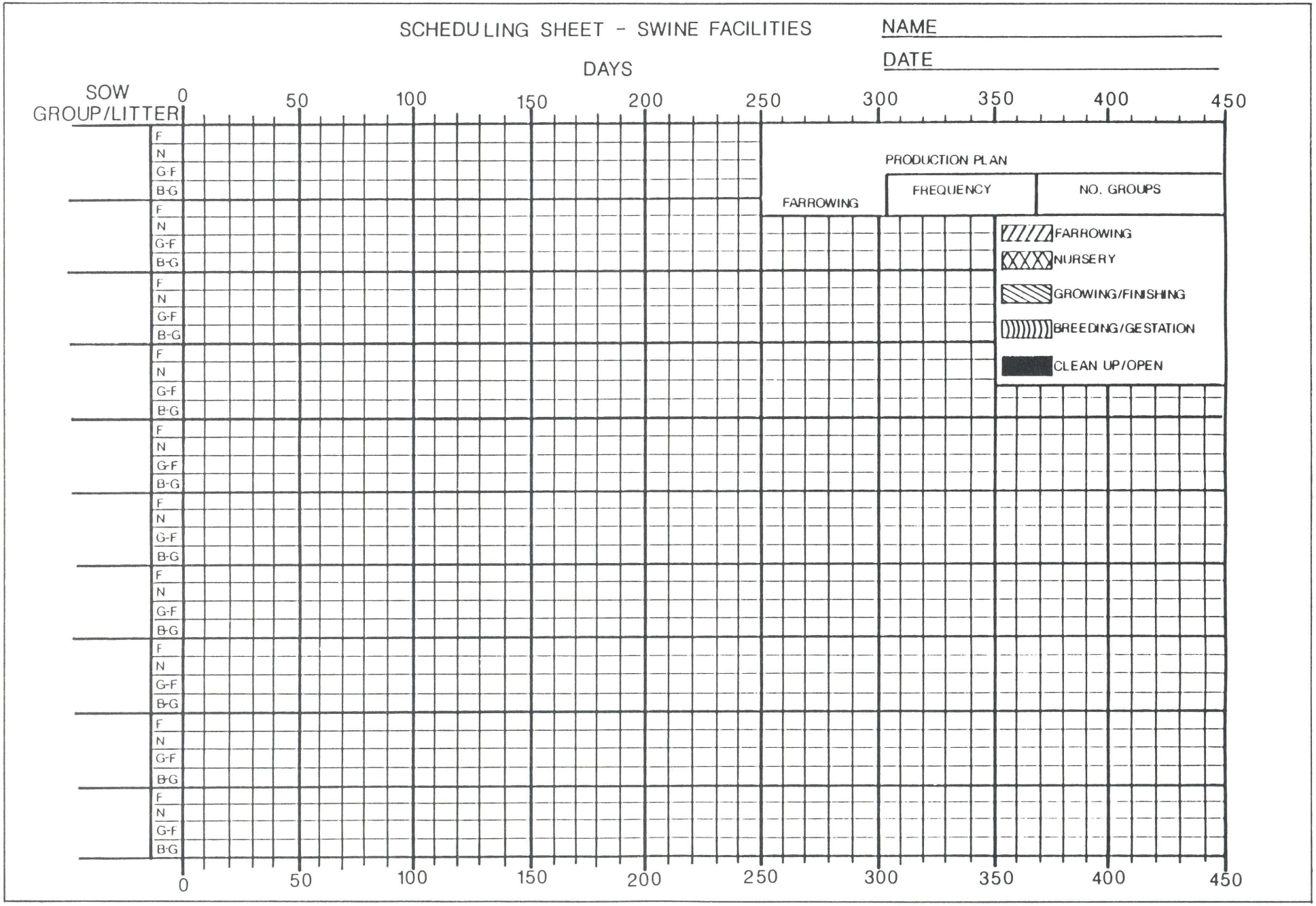

Figure 2. This blank schedule is provided for your use.