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

Michigan State University Extension

Calculating Swine Schedules

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Pork producers generally want an even flow of livestock through their facilities; high building occupancy without overcrowding; and 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 reproductive 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/lactation. The gestation period is the most fixed of these values—about 16 1/2 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 to 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 days to 7 days). Weaning at ages less than 3 weeks tends to widen this range, often to 9 or even 10 days on the high end. 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 ranges and age ranges of weaned pigs, producers must strive to minimize the time interval at which sows are bred and thereby the ranges 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. An exception is sows whose pigs were weaned below 3 weeks. In a very intensive weekly system, it may be feasible to move unbred sows into the next sow group entering breeding, and add gilts or sows from the earlier group that were late

in reaching estrus. 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, but increases the ranges of age and weight in pig groups.

Conception rates are affected by seasonal factors, but these factors are not 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 usually not economical 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-8, Managing Sows and Gilts for Efficient Reproduction for more information.

Table 1. Typical swine growth ranges.

Production stage	Age (weeks)	Weight (lb)
Farrowing	0-6	3-30
Nursery	2-12	8-100
Growing-Finishing	8-28	60-270

Weaning age. The typical weaning age used in the U.S. is 3 to 4 weeks, with a range of 2 to 6 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 allowable 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 grow-finish animals are shown in Table 1. Ages of market hogs range from 21 to 28 weeks with an average of about 25 weeks in inside facilities.

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

Worksheet for computing a swine production schedule

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

Example Situation: A farmer wishes to construct a new farrow-to-finish unit. The plan is to use a one-room, 20-crate farrowing house. He hopes to wean 9 pigs per litter and finish animals in 180 days. Because of other demands on labor, at least 10 days is needed for cleanup in farrowing and females will be pen bred at first heat. Enough boars will be used to use each boar only once a day. His goal is a conception rate of 80%, although it is expected 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 4 days greater than minimum age for first heat breeding, 8 days greater for second heat breeding):		_____
c. Average number weaned per litter:	*9*	_____
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 + minimum gestation period (3 + 37 + 113)	*153 days*	_____
b. Total number of sow groups: (Step 5.a x Step 1.a) ÷ Step 4.b (((153 x 1) ÷ 47) = 3.1) Truncate result if not a whole number	*3*	_____
c. Actual IBF: (Step 5.a x Step 1.a) ÷ Step 5.b ((153 x 1) ÷ 3 = 51) Round off result if not a whole number	*51 days*	_____
d. Number of sow groups per farrowing 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 ((3 x 20 x 100) ÷ 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 (1 x 5)	*5*	_____
d. Sow capacity in breeding: Step 11.b x 100 3 Step 3.e (round answer off to next highest whole number) (20 x 100 ÷ 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 hightest 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 ((2.38 x 20 x 3) ÷ 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) (20 x 2.38 x 3)	*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 9)	*1288*	_____
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 9)	*180*	_____
g. Number of pig groups from birth to market:†† Step 7 e ÷ Step 5.f (round off result to next highest number, e.g., 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.

Table 2A. Schedule for 1 room, 14 days open, 3 groups of sows, farrow every 51 days, wean age = 29-37 days.

SWINE SCHEDULING EXAMPLE #1 (All table values are in days)

Group*	Farrowing**		Wean†	Breeding		Enter	Enter	Enter	Marketing††
	Enter	Begin		Begin	End	Nursery	Growing	Finishing	Begin
A1	1	5	42	45	49	42	93	144	195
B1	52	56	93	96	100	93	144	195	236
C1	103	107	144	147	151	144	195	246	287
A2	154	158	195	198	202	195	246	297	338
B2	205	209	246	249	253	246	297	348	389
C2	256	260	297	300	304	297	348	399	440
A3	307	311	348	351	355	348	399	450	491
B3	358	362	399	402	406	399	450	501	542
C3	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, B3 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, 6 days open, 4 groups of sows, farrow every 36 days, wean age = 20-30 days.

Group	Farrowing		Wean	Breeding		Enter	Enter	Marketing
	Enter	Begin		Begin	End	Nursery	Grow-Finish	Begin
A1	1	4	34	37	44	34	70	184
B1	37	40	70	73	80	70	106	220
C1	73	76	106	109	116	106	142	256
D1	109	112	142	145	152	142	178	292
A2	145	148	178	181	188	178	214	328
B2	181	184	214	217	224	214	250	364
C2	217	220	250	253	260	250	286	400
D2	253	256	286	289	296	286	322	436
A2	289	292	322	325	332	322	358	472
B3	325	328	358	361	368	358	394	508
C3	361	364	394	397	404	394	430	544
D3	397	400	430	433	440	430	466	580

Table 2C. Schedule for 1 room, 4 days open, 5 groups of sows, farrow every 28 days, wean age = 17-24 days.

Group	Farrowing		Wean	Breeding		Enter	Enter	Marketing
	Enter	Begin		Begin	End	Nursery	Grow-Finish	Begin
A1	1	3	27	30	34	27	55	183
B1	29	31	55	58	62	55	83	211
C1	57	59	83	86	90	83	111	239
D1	85	87	111	114	118	111	139	267
E1	113	115	139	142	146	139	167	295
A2	141	143	167	170	174	167	195	323
B2	169	171	195	198	202	195	223	351
C2	197	199	223	226	230	223	251	379
D2	225	227	251	254	258	251	279	407
E2	253	255	279	282	286	279	307	435
A3	281	283	307	310	314	307	335	463
B3	309	311	335	338	342	335	363	491
C3	337	339	363	366	370	363	391	519
D3	365	367	391	394	398	391	419	547
E3	393	395	419	422	426	419	447	575

Table 2D. Schedule for 2 rooms, 11 days open, 7 groups of sows, farrow every 21 days, wean age = 24-31 days.

Group	Enter Farrowing House 1*	2	Begin Farrowing	Wean	Breeding Begin	End	Enter Nursery 1	2	Enter Growing	Finish	Marketing† Begin
A1	1		5	36	39	44	36		78	120	185
B1		22	26	57	60	65		57	99	141	206
C1	43		47	78	81	86	78		120	162	227
D1		64	68	99	102	107		99	141	183	248
E1	85		89	120	123	128	120		162	204	269
F1		106	110	141	144	149		141	183	225	290
G1	127		131	162	165	170	162		204	246	311
A2		148	152	183	186	191		183	225	267	332
B2	169		173	204	207	212	204		246	288	353
C2		190	194	225	228	233		225	267	309	374
D2	211		215	246	249	254	246		288	330	395
E2		232	236	267	270	275		267	309	351	416
F2	253		257	288	291	296	288		330	372	437
G2		274	278	309	312	317		309	351	392	458
A3	295		299	330	333	338	330		372	414	479
B3		316	320	351	354	359		351	393	435	500
C3	337		341	372	375	380	372		414	456	521
D3		358	362	393	396	401		393	435	477	542
E3	379		383	414	417	422	414		456	498	563

* There are a total of 11 days open between farrowing (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 2E. Schedule for 2 farrowing rooms, 4 nursery rooms, 5 days open, 10 groups of sows, farrow every 14 days, wean age = 16-23 days.

Group	Enter Farrowing Rm 1	Rm 2	Begin Farrowing	Wean	Breeding Begin	End	Enter Nursery Rm 1	Rm 2	Rm 3	Rm 4	Enter Grow-Finish	Marketing Begin
A1	1		3	26	29	32	26				82	183
B1		15	17	40	43	46		40			96	197
C1	29		31	54	57	60			54		110	211
D1		43	45	68	71	74				68	124	225
E1	57		59	82	85	88	82				138	239
F1		71	73	96	99	102		96			152	253
G1	85		87	110	113	116			110		166	267
H1		99	101	124	127	130				124	180	281
I1	113		115	138	141	144	138				194	295
J1		127	129	152	155	158		152			208	309
A2	141		143	166	169	172			166		222	323
B2		155	157	180	183	186				180	236	337
C2	169		171	194	197	200	194				250	351
D2		183	185	208	211	214		208			264	365
E2	197		199	222	225	228			222		278	379
F2		211	213	236	239	242				236	292	393
G2	225		227	250	253	256	250				306	407
H2		239	241	264	267	270		264			320	421
I2	253		255	278	281	284			278		334	435
J2		267	269	292	295	298				292	348	449

Table 2F. Schedule for 3 rooms, 4 nursery rooms (2 grps/rm), 2 days open, 19 groups of sows, farrow every 7 days, wean age = 12-19 days.

	Enter Farrowing			Begin		Breeding		Enter Nursery				Enter	Marketing
Group	Rm 1	Rm 2	Rm3	farrowing	Wean	Begin	End	Rm 1	Rm 2	Rm 3	Rm 4	grow-finish	begin
A_1	1			2	21	24	28	21				77	182
B_1		8		9	28	31	35	28				77	189
C_1			15	16	35	38	42		35			91	196
D_1	22			23	42	45	49		42			91	203
E_1		29		30	49	52	56			49		105	210
F_1			36	37	56	59	63			56		105	217
G_1	43			44	63	66	70				63	119	224
H_1		50		51	70	73	77				70	119	231
I_1			57	58	77	80	84	77				133	238
J_1	64			65	84	87	91	84				133	245
K_1		71		72	91	94	98		91			147	252
L_1			78	79	98	101	105		98			147	259
M_1	85			86	105	108	112			105		161	266
N_1		92		93	112	115	119			112		161	273
O_1			99	100	119	122	126				119	175	280
P_1	106			107	126	129	133				126	175	287
Q_1		113		114	133	136	140	133				189	294
R_1			120	121	140	143	147	140				189	301
S_1	127			128	147	150	154		147			203	308
A_2		134		135	154	157	161		154			203	315

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 the nursery, and the space in the nursery taken up by a new group moved in from farrowing, and so on. Therefore, all buildings in the production process should be sized to hold a given 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 1 1/2 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.

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 2F, 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 2F 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. No pig mortality or gilts removed for breeding are included in these 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 farrowing room systems can be done quickly and easily using the numerical solution outlined here. The calculations lend themselves to development of a computer program or spreadsheet that allows the producer to evaluate a wide range of schedules.

Table 3. Summary design table of building capacities needed per 10 sows farrowed per period* (80% average conception rate, no gilts returned, all schedules on 1st heat breeding).**

	# of crates needed in farrowing	# of sow groups	Total # of sows	Sow cap. in gestation	Sow cap. in post farrow	# of boars	Interval between farrowing (days)	Farrow per yr.	# of sows and litters in sow-pig nursery	Number of pigs in Nursery	Growing	Finish.	# pigs mkt./ year
1.	10	3	39	24	15	3	51	7X	-	90	90	90	630
2.	10	4	51	36	15	5	37	10X	5	90	180	180	900
3.	10	5	63	48	15	5	28	12X	10	90	180	90	1,080
4.	20 (in 2 rooms)	7	85	60	15	3	21	17X	-	180	180	270	1,530
5.	30 (in 3 rooms)	11	131	96	15	4	14	26X	-	270	270	360	2,340
6.	50 (in 3 rooms)	19	242	168	15	4	7	Weekly	-	360	720	900	4,680

* Assume 9 pigs weaned per litter. To plan for a different litter size, adjust capacities in table by dividing by 9 and multiplying by desired litter size.

** 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 1 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 so-pig nursery is needed, and the pig nursery should hold 90 x 2.4 = 216 pigs. The growing area capacity should also be 90 x 2.4 = 216, and the fininishing building should hold 90 x 2.4 = 216. The producer can market 575 x 2.4 = 1,380 hogs per year.

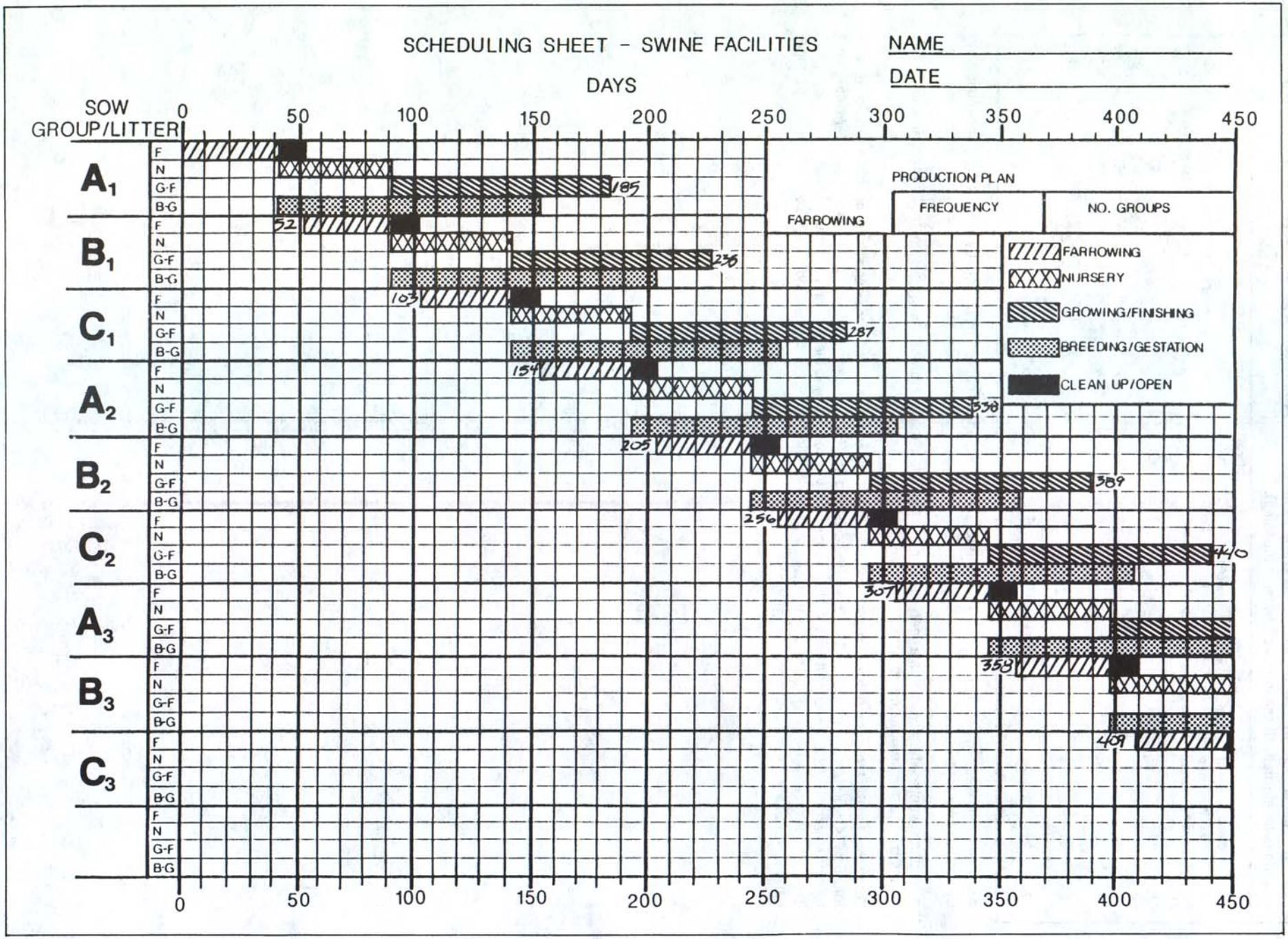

Figure 1. Example from Table 2a, represented graphically.

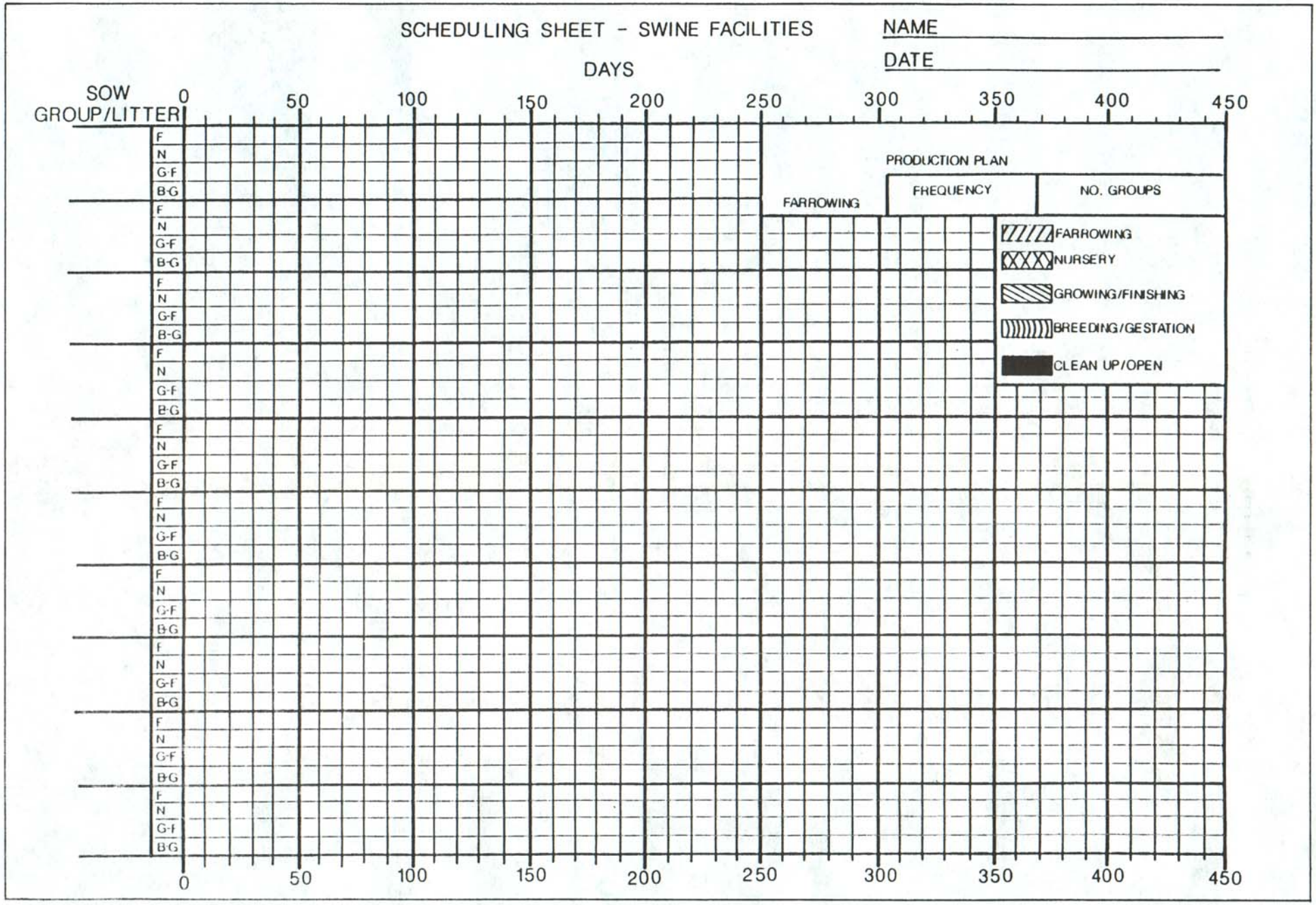

Figure 2. This blank schedule is provided for your use.

Major Rev., destroy old, 1M-10:98, KMF/FP, $1.20, for sale only