

Observations on the Use of 6-methyl-17-acetoxypregesterone (Provera¹) for the synchronization of estrus in ewes

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Individual open ewes exhibit estrus (heat) about every 16-17 days during those seasons of the year when they are sexually active. Among a large flock of open ewes, there will be ewes exhibiting estrus every day. There are reasons why it would be desirable to have all ewes exhibit estrus on the same day or during a very few days.

For about twenty-five years it has been known that small injections of the pregnancy hormone, progesterone, would prevent ewes from exhibiting estrus. More recently progesterone-like compounds that can be fed have been developed. Research workers have shown that when these compounds are fed during the regular breeding season, the ewes will stop exhibiting estrus during the feeding period. When feeding of the drug is halted, most if not all ewes will exhibit estrus on the 2nd or 3rd day thereafter.

A series of trials have been conducted using one of these compounds (6-methyl-17-acetoxypregesterone or Provera) to test its possible use in relation to the spring breeding of ewes or for speeding up the rebreeding of lactating ewes. This report summarizes these trials.

MATERIALS AND METHODS

The procedure for the administration of Provera has been essentially the same in all trials. The drug is mixed into the feed at a rate such that each one-half pound of feed will contain the daily dosage for one ewe. The feed must be highly palatable so that all ewes will eat it. It should be fed at a time of day when all ewes are hungry. Enough trough space must be provided to allow all ewes to eat at once. In these trials the feed used was a mixture of 50% ground alfalfa, 45% ground sorghum grain and 5% molasses. The drug must be fed to the ewes for about 15 days.

Various observations were made during one or more of the trials as follows:

Mating records—either teaser or fully fertile rams were equipped with marking harnesses and the ewes observed once or twice daily to

¹ Provera is the trade name of the compound used in these trials. It is manufactured and was furnished by the Upjohn Co., Kalamazoo, Michigan.

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record all ewes with fresh marks. (This system is not perfect as some mated ewes are not marked and some marked ewes are not mated but about 90% of the records are correct).

Laparotomies—some ewes were anesthetized a few days following mating, a surgical incision was made into the abdominal cavity and the ovaries examined to determine whether an ovulation had occurred. This is an exact method of determining ovulation rate or ovulation failures.

Lambing records—all ewes were allowed to lamb if a fertile male was used at breeding time. Some ewes died and thus their lambing records could not be compared to their mating records. The lambing records included the date of lambing and the number of lambs born.

TRIAL I

This trial was conducted to determine the effectiveness of estrus synchronization by feeding Provera, and to compare the conception and lambing rate of ewes that received Provera to like ewes that did not receive Provera.

During the 1962 spring breeding season 23 ewes, 12 Dorset X Western and 11 Merino X Rambouillet, were fed 60 mg. Provera per head per day for the first 15 days of the breeding season. Twenty-three ewes of like breeding were maintained on the same feed ration without the Provera. Both groups of ewes were together on pasture except at feeding time. The Provera feeding period was from May 20 to June 3. The ram was with the ewes from May 22 to June 30.

Seven of the 12 Dorset X Western ewes mated during the Provera feeding period indicating that the 60 mg. level was not sufficient to suppress estrus in all of these ewes during this time of the year. One of the ewes that mated was laparotomized and she had not ovulated. None of the Merino X Rambouillet ewes mated during the Provera feeding period.

The breeding and lambing performance of the Provera fed group and the group that received no Provera (the control group) is summarized in Table 1.

The Dorset X Western ewes that received Provera all mated during a three day period from the third to the fifth day after the last day of Provera feeding. The Merino X Rambouillet ewes that received Provera all mated during a four day period from the third to the sixth day after the last day of Provera feeding. The first estruses of the ewes of the control group were scattered over a 24 day period. Two of the control group ewes, one of each breed group, did not mate during the breeding season.

Laparotomies were performed on all the Dorset X Western ewes approximately five days after they mated to determine if the ewes had

Table 1. Breeding and Lambing Results from Trial I

	Dorset X Western ewes ¹		Merino X Rambouillet ewes	
	Provera group	Control group	Provera group	Control group
No. of ewes at beginning of trial	12	12	11	11
Range of first estruses in days ²	3	24	4	24
First estrus conceptions	5	2	5	6
No. of lambs from first estrus conceptions	7	2	5	8
Second estrus conceptions	1	6	4	3
No. of lambs from second estrus conceptions	1	8	4	4
No. of ewes not mating during breeding season	0	1	0	1
No. of ewes not lambing	3	3	2	2
No. of ewe alive at lambing ³	9	11	11	11

¹ The Dorset X Western ewes of both groups were laparotomized after their first estrus.

² For the Provera groups the ranges in days refer to the first synchronized estruses following the 15 day Provera feeding period.

³ Three of the Dorset X Western ewes from the Provera group and one from the control group died as a result of the laparotomies.

ovulated and how many ova were shed. The control ewes were laparotomized after their first recorded mating, but ewes receiving Provera were laparotomized only after the first mating that occurred after Provera feeding had ended. Two of the Dorset X Western ewes that had mated during the Provera feeding period had not ovulated at the synchronized estrus mating. Ovulation rate for the Dorset X Western ewes that had received Provera and had ovulated was 1.33 ova per ewe and for the Dorset X Western control ewes was 1.55 ova per ewe.

Five of the 11 Merino X Rambouillet ewes that received Provera conceived at the first estrus after Provera feeding ended and produced five lambs. Four of the remaining Provera fed ewes lambed from return estruses and produced four lambs. Two of the Provera fed ewes did not lamb. Six of the 11 control ewes conceived at their first estrus and produced eight lambs. Three of the control ewes conceived at their next return estrus and produced four lambs, leaving two control ewes that did not lamb.

The effect of the laparotomy operations upon subsequent lambing performance is not known, but it is possible that the operation will increase embryonic mortality in the ewes that have conceived. This is indicated by the low first estrus conception shown by the Dorset X Western ewes, particularly the control group ewes. Five of the Dorset X Western ewes that received Provera conceived at the first synchronized estrus and produced seven lambs. Two of the control group ewes conceived at their first estrus and produced two lambs. Three of the Pro-

vera fed ewes and one of the control ewes died as a result of the laparotomies. Information on conception was not obtained on these ewes. Of the remaining four Provera group ewes that did not conceive at their first estrus one conceived at the next return estrus and produced a single lamb, leaving three ewes that did not lamb. Of the remaining control group ewes six conceived at their first return estrus and produced eight lambs and three ewes did not lamb.

Even though the level of Provera was not high enough to block apparent estrus, these results indicated that with May and June breeding the product would definitely control the time of first estrus. The information on conception and ovulation rate was not extensive enough to draw firm conclusions.

TRIAL II

The purpose of this trial was to compare the effectiveness of estrus synchronization by feeding Provera both with and without PMS¹ injection at the end of the Provera feeding period.

Thirty-seven head of yearling ewes, twenty Dorset X Western and seventeen Rambouillet, were fed 60 mg. Provera per head per day for 15 days, from October 5 to October 20, 1962.

One-half of each of the above breed groups was injected with 500 I. U. PMS 36 hours after the last feeding of Provera. PMS stimulates the development of ovarian follicles and should cause an increased ovulation rate. With an increased ovulation rate the potential for multiple births should be increased, also the number of ewes conceiving at the first estrus should be increased.

Two fertile rams were alternated, one during the day and one at night, with the ewes for 25 days beginning the last day that Provera was fed. All 18 of the ewes that received Provera but no PMS mated within five days after the last day that Provera was fed. Eighteen of the 19 ewes that received both Provera and PMS mated within the same five day period, one ewe mated 20 days after the last day that Provera was fed.

Eight of the 10 Dorset X Western ewes in both the Provera feeding group and Provera feeding plus PMS injection group conceived at the first synchronized estrus following the end of the Provera feeding period. Eleven lambs were produced by the above eight ewes in each group. The remaining two ewes in each group conceived at the second estrus after the end of the Provera feeding period and each ewe produced a single lamb.

¹ Pregnant Mare Serum (PMS) is a commercial product that when injected in adequate dosages will cause ovulation. PMS has in the past been used with varying results in an attempt to initiate and synchronize estrus.

Six of the nine Rambouillet ewes that received only Provera conceived at the first synchronized estrus and produced six lambs. The remaining three ewes of this group did not lamb. Four of the eight Rambouillet ewes that received both Provera and PMS conceived at the first synchronized estrus and produced six lambs. One ewe conceived at her second estrus and produced a single lamb, and the remaining three ewes did not lamb.

Estrus synchronization was effective in this trial with 36 of the 37 ewes mating within five days after the Provera feeding period ended. In this trial PMS did not greatly increase the total number of lambs born as the group of ewes that received PMS produced only one more lamb than the group receiving no PMS. All the Dorset X Western ewes from both the Provera fed group and the Provera plus PMS group lambled. Three Rambouillet ewes from each group (PMS or no PMS) did not lamb.

TRIAL III

Rebreeding ewes shortly after lambing and during lactation may be necessary in some types of intensive sheep production. This trial was conducted to study the possible effects of Provera feeding upon lactation and the subsequent breeding performance of ewes that had recently lambled.

Forty-eight mature ewes, 24 Dorset X Western and 24 Western, that had lambled within a six day period, November 4 to 10, were allotted to two groups. The 24 ewes in one of these groups were fed 70 mg. Provera per head per day for 17 days, beginning when their lambs were an average of 15 days of age. The other group served as a control and was maintained under similar conditions without receiving Provera in their feed. Vasectomized teaser rams were run with the ewes and matings were recorded for 69 days, beginning the first day of the Provera feeding period.

Milk production of the ewes in both groups was measured three times, one day before the Provera feeding began, during the first week of Provera feeding and during the second week of Provera feeding. Provera feeding apparently had no effect on milk production.

None of the ewes that were fed Provera mated at the time Provera feeding ended but 14 of the 24 ewes of this group mated 17 to 24 days following the last day of the Provera feeding period. Three other ewes mated 35, 38 and 44 days after the last day of the Provera feeding period. The ewes not mating until about three weeks after the Provera feeding period can be explained since ewes usually have a silent heat period, and do not breed, at their first ovulation following lambing. In this case the first ewe mated 46 days after lambing and the last ewe 81 days after lambing. The average interval from lambing to first mating was 55 days. Eleven of the control ewes mated from 39 to 69 days after lambing and there was an average interval from lambing to first mating of 53 days.

Since none of the ewes were allowed to mate to fertile rams no information was obtained on conception and lambing.

In this trial the feeding of Provera did not influence the amount of milk produced. A 17 day Provera feeding period was not followed immediately by the exhibition of estrus, but did tend to synchronize the exhibition of the estrus which occurred about three weeks after the end of the Provera feeding period.

TRIAL IV

As shown in Trial III Provera feeding apparently had no adverse effect upon lactation and did tend to synchronize the first estrus exhibited by ewes with young lambs. This trial was conducted to further study the influence of Provera feeding, with and without PMS injections, upon the breeding performance of lactating ewes and the effect upon their subsequent lambing performance.

The 37 ewes that were previously discussed in Trial II were all fed 60 mg. per head per day of Provera for 13 days, April 1 to 13, beginning when the oldest lambs were 17 days of age. When Provera feeding began three of the ewes had not lambed, and were added to the group receiving Provera when their lambs were two days old. The six dry ewes remained with the group and received Provera the full 13 day period. At the end of the Provera feeding period the ewes were equally divided into two groups, the groups being as equal as possible as to breed, age of lambs, number of ewes having twins or singles and number of dry ewes. The ewes of one group were injected with 500 I.U. PMS 24 hours after the last feeding of Provera, the other group received no injection. A ram was put with the ewes on the first day of the Provera feeding period and ran with the ewes continuously for 90 days.

All the Rambouillet ewes were laparotomized one week after the end of the Provera feeding period. Of all the ewes that received PMS at the end of the Provera feeding period, three dry ewes and six with lambs, ovulated. Only one of the ewes, a dry ewe, that did not receive PMS ovulated.

Four ewes, three Dorset X Western and one Rambouillet, mated between 22 and 25 days after the last day of the Provera feeding. One of the three Dorset X Western ewes lambed from this mating and produced a single lamb. All four of the ewes that mated had lambed and were lactating. These were the only matings recorded during the 90 day breeding season, although one Rambouillet ewe lambed from a mating about 90 days after the beginning of the Provera feeding period.

There are several possible reasons why breeding performance was not good with this group of ewes. They were young ewes raising their first lamb crop, consequently it was difficult to keep the ewes in good condition during lactation. The breeding season began in April which is

usually a relatively inactive breeding period, which might explain the failure of the six dry Rambouillet ewes to mate.

As was observed in Trial III, the Provera feeding period during early lactation was not followed by the immediate initiation of estrus.

The Rambouillet ewes that had lambled, and had not received PMS, had not ovulated when examined by laparotomy one week after the Provera feeding period. All ewes that received PMS injections had ovulated but in no case did a ewe exhibit estrus until about three weeks after the Provera feeding period.

TRIAL V

In this trial a large group of spring bred ewes were bred at the second estrus after feeding Provera. The factors in reproduction that were studied including the effectiveness of estrus synchronization, conception rate and lambing rate.

Two-hundred and five mature ewes were allotted to two groups before the spring breeding season in 1963. The two groups were balanced as to bred and age of the ewes. One-hundred and three of the ewes, 48 Dorset X Western and 55 Western ewes, were fed 70 mg. Provera per head per day for 16 days, beginning 32 days before the regular spring breeding season (May 20 to June 29). The other group of 102 ewes, 50 Dorset X Western and 52 Western ewes, were fed the same feed ration without the Provera.

The objective in having the Provera feeding period end 16 days before the beginning of the breeding season was to allow the ewes to mate to fertile rams at their second synchronized estrus. Other research workers have, in some cases, reported a lowered conception rate from breeding at the first synchronized estrus. By breeding at the second synchronized estrus it was anticipated that the conception rate of the ewes receiving Provera would be about the same as that of the ewes receiving no Provera.

Although no attempt was made to completely record individual matings, vasectomized teaser rams were run with both groups of ewes during the time after the Provera feeding period and before the regular breeding season. These observations confirmed that many of the Provera group ewes mated at the first synchronized estrus to the teaser rams.

At the beginning of the regular breeding season all the ewes were allotted at random into four breeding groups. Each breeding group was composed of approximately one-half Provera fed ewes and one-half control group ewes. Two rams were assigned to each breeding group. One Dorset ram and one Hampshire ram were assigned to each of two groups and one Dorset and one Suffolk ram were assigned to each of the other two groups. The rams were rotated every day, each ram being with the ewes every other day.

The number of matings for each week of the breeding season and the number of resulting conceptions are shown in Table 2. Estrus synchronization was very effective in the Provera fed group as 95 of the 103 ewes mated during the first week of the breeding season. An additional four Provera group ewes mated the second week, making a total of 99 of the 103 Provera fed ewes mating the first two weeks. Three more ewes of this group mated the fourth week and one ewe did not mate. It is possible that the ewes that mated the fourth week had mated, but were not recorded, during the first two weeks.

Thirty-seven of the 102 control group ewes mated the first week and 49 more mated the second week for a total of 86 of the 102 ewes the first two weeks of the breeding season. Judging from past years performance the control group ewes mated unusually well at the beginning of the breeding season. Since all the ewes were fed for the 16 day Provera feeding period it is possible that this supplemental feed in some way contributed to the better than expected breeding performance of the control group ewes early in the breeding season. No ewes mated for the first time during the last 12 days of the breeding season and few return matings were recorded during this period. This is difficult to explain since eleven of the Provera fed ewes did not lamb and nine of the control group ewes did not lamb.

Table 2. Matings and Conceptions for Trial V

	Provera Group	Control Group
No. of ewes	103	102
First week: ¹		
No. first estrus matings	95	37
No. first estrus conceptions	77	34
Second week: ¹		
No. first estrus matings	4	49
No. first estrus conceptions	3	44
Third week: ¹		
No. first estrus matings	0	9
No. first estrus conceptions	0	8
Fourth week: ¹		
No. first estrus matings	3	3
No. first estrus conceptions	3	2
Last 12 days: ¹		
No. first estrus matings	0	0
Total no. first estrus matings	102	98
Total no. first estrus conceptions	83	88
No. second estrus conceptions	8	4
No. third estrus conceptions	1	1
Total No. conceptions	92	93
No. ewes not lambing	11	9
No. ewes not mating	1	4

¹ Periods of the forty day breeding season May 20-June 29.

The number of first estrus conceptions for each week of the breeding season and the number of second and third estrus conceptions, with the number of lambs resulting from each are given in Table 3. The corresponding number of matings, as previously discussed, are shown in Table 2.

Although only eight rams were used with the 205 ewes, conception rates were very acceptable. Of the 95 Provera group ewes that mated the first week 77 or 81 percent conceived. Thirty-seven control group ewes mated the first week and 34 or 92 percent of these conceived. Over the whole breeding season first service conception rate was 81 percent for the Provera fed ewes and 90 percent for the control group ewes. Eight of the Provera group ewes conceived to second estrus matings and one to a third estrus mating. Four of the control group ewes conceived to second estrus matings and one to a third estrus mating. One Provera group ewe and four control group ewes did not mate during the breeding season.

Lambing rates were very comparable between the Provera group and the control group. The 103 Provera fed ewes produced 133 lambs from 92 conceptions and the 102 control group ewes produced 137 lambs from 93 conceptions. Eleven of the Provera fed ewes and nine of the control group ewes did not lamb.

The lambing results by breed of ewe within the Provera fed group and the control group are given in Table 4. The 48 Dorset X Western ewes that received Provera produced 64 lambs and the 50 Dorset X Western ewes that received no Provera produced 77 lambs. The 55 Western ewes that received Provera produced 69 lambs and the 52 ewes that received no Provera produced 60 lambs. These results indicate that feeding Provera may have reduced the lambing rate of the Dorset X Western ewes and increased the lambing rate of the Western ewes. However, the differences that were observed are not large and may have

Table 3. Conceptions and number of lambs born for Trial V

	Provera Group		Control Group	
	No. Conceptions	No. Lambs Born	No. Conceptions	No. Lambs Born
First Estruses				
1st Week	77	113	34	52
2nd Week	3	4	44	65
3rd Week	0	0	8	11
4th Week	3	5	2	2
Last 12 days	0	0	0	0
Total 1st Estruses	83	121	88	131
Second Estruses	8	10	4	6
Third Estrus	1	1	1	1
Group Totals	92	133	93	137

Table 4. Lambing rate of the Dorset X Western and Western ewes on Trial V.

	Provera Group	Control Group	Total by Breed of ewe
Dorset X Western ewes			
No. of ewes	48	50	98
No. of lambs	64	77	141
Western ewes			
No. of ewes	55	52	107
No. of lambs	69	60	129
Total of both breeds			
No. of ewes	103	102	205
No. of lambs	133	137	270

been due to chance variation in lambing rates. As can be observed from Table 4 the overall lambing rate for the Dorset X Western ewes was considerably higher than for the Western ewes.

In this trial estrus was very effectively synchronized by feeding Provera for 16 days beginning 32 days before the beginning of the breeding season and allowing the ewes to breed at the second synchronized estrus. First estrus conception rate was lower for the Provera fed group than for the control group, but it appears that the first estrus conception rate of the control group ewes was unusually high. The lambing rate for the Provera fed group was only slightly less than that for the group not fed Provera. However, the Provera feeding may have reduced the lambing rate of the Dorset X Western ewes and increased the lambing rate of the Western ewes.

TRIAL VI

This trial was conducted to determine if a Provera feeding period would aid in increasing the number of fall born ewe lambs that would mate and conceive during the regular 30 day late summer breeding season.

Beginning July 30, 1963, 20 head of ewe lambs, born the previous fall, were fed 50 mg. Provera per head per day for 12 days. Twenty head of ewe lambs of like age and breed were fed the same ration without the Provera. Twenty of the 40 head of ewes were Dorset X Western, 10 head were $\frac{3}{4}$ Dorset- $\frac{1}{4}$ Western and 10 head were $\frac{3}{4}$ Rambouillet- $\frac{1}{4}$ Dorset.

Two vasectomized teaser rams were put with the 40 ewes for three weeks before the Provera feeding period began. Twelve of the 20 control group ewes and 17 of the 20 Provera group ewes mated to the teaser rams during this period. The ewe lambs that did not mate may not have been sexually active at this time.

A fertile ram was put with both groups of ewes 10 days after the end of the Provera feeding period, on August 20 and remained for a 30 day breeding period. This allowed the Provera fed ewes to mate to the fertile ram at their second synchronized estrus.

All of the Provera group ewes mated but synchronization of estrus was rather ineffective. The first estrus matings of the Provera fed group were spread over a 19 day period with six of the 20 ewes mating the first week, 13 mating the second week and one ewe mating the third week of the breeding season.

All of the control group ewes mated over a 29 day period, six during the first week of the breeding season, 10 during the second week, and four during the third week.

The second synchronized estrus of the Provera fed group should have occurred during the second week of the breeding season. Since 13 of the 20 Provera fed ewes mated during the second week of the breeding season there was a tendency for the ewes to remain synchronized. But, in comparison, 10 of the 20 control group ewes mated during the same period.

Fifteen of the Provera group ewes lambed, ten from first estrus conceptions and five from second estrus conceptions. Thirteen of the control group ewes lambed, eight from first estrus conceptions and five from second estrus conceptions. All the ewes that lambed, in both the Provera fed group and the control group, produced single lambs.

The failure of effective estrus synchronization in this trial might have been contributed to by several factors. Past experiences has shown that conception rate is not high in ewe lambs and it is possible that some of the ewes were not having regular estrual cycles when the Provera feeding period began. If the ewes were having estrual cycles of very irregular length much of the synchronization effect might have been lost by waiting until the second estrus to breed the ewes.

SUMMARY

Estrus was effectively synchronized in three of four trials with non-lactating ewes. In one trial with late summer breeding of ten month old ewe lambs estrus was not well synchronized when the ewes were allowed to mate at the second estrus after the end of the Provera feeding period. In these trials lambing rate of ewes that had received Provera was about equal to that of ewes receiving no Provera.

In two trials in which Provera was fed to lactating ewes it was found that the ewes did not exhibit estrus and mate immediately after the end of the Provera feeding period. However, estruses that occurred about three weeks after the end of the Provera feeding period tended to be synchronized. In one trial with lactating ewes the injection of PMS at the end of the Provera feeding period caused ovulation but not estrus. Provera feeding, either with or without PMS injection, did not appear to hasten the occurrence of estrus in lactating ewes. The feeding of Provera to lactating ewes was found to have no effect on milk production.