CHAPTER 4

Favourable influence of hyper. or hypocorticalism over that of step-down photoperiod in pullets but,not in adult of RIR breed of domestic fowl.

Introduction:

Light as an environmental factor capable of controlling reproductive functions in female domestic birds, in terms of egg production was realized by the observations of stimulated egg production under supplementary artificial lighting schedules. Also, sexual maturity, egg weight and total egg yield, are all affected greatly by the duration of photoperiod in the rearing period . These observed photoperiodic responses of the domestic hen were inferred to be related to a change in day length, rather than to absolute day length (Hutchison and Taylor, 1957). This has been borne out by the many studies employing different photoperiodic schedules, all of which resulted in attainment of sexual maturity at approximately 22-24 weeks of age (see Lewis *et al.,* 1994; Etches, 1996). The minimum constant photoperiod, for optimal laying performance in the domestic hen, has been worked out to be 10hrs and further, in terms of a changing photic schedule it has been deduced to be a step-up schedule ranging from 8h to 16h, and the most sensitive period in pullets has been noted to be between 9 and 12 weeks of age (Morris, 1963, 1964; Lewis *et al.*, 1992). A step-down photic schedule involving rearing of pullets initially under a long photoperiod followed by shifting them to a short photoperiod is reported to delay sexual development and, to have a negative impact on the rate of lay (Morris, 1994). Recently, Lewis *et al.* (1996 b) reported that the reduction in photoperiod from 18h to 8h, reduced egg output while, a change from 13h to 8h, had a positive effect on egg weight in ISA Brown and Shaver 288 breeds. In a subsequent study, they have also showed that a reduction in photoperiod from 13h to 8h, delayed initiation of egg laying (IL) by 22 days when given at 84 days and, by 16 days at when given 119 days. A similar 5h reduction in photoperiod from 18h to 13h, delayed IL by 11 days in ISA Brown pullets, only when given at 84 days and, delayed by 12 days in Shaver 288, when given at 119 days (Lewis *et al.,* 1996 c). A similar delay in IL by 28 days was observed even in the Indian RIR breed when the photoperiod was reduced from 18h to 12h. However, termination of egg laying occurred significantly earlier in these birds, with a better rate of lay in terms of egg/day yield as well as oviposition interval (see chapter 2). The above reported differences in the photoperiodic response in ISA Brown, Shaver 288 and Indian RIR breeds, can be accredited to possible genetic differences as has been inferred earlier (Shanawani 1983; Dandekar,1998; chapter 2).

Based on recent studies on mammals, the influence of adrenal corticoids and thyroid hormones on reproductive functions is being envisaged, besides, the primary control exerted by the pituitary gonadortophins (Palmero *et al.,* 1988). In this respect, differential but definite interrelationships between the thyroid and adrenal on one hand, and gonads on the other, have been reported in different species (See chapter 3). The above study (chapter 3) evaluated the effects of hypercorticalism(HPR) or hypocorticalism (HPO) in the sexually immature growing pullets on attainment of sexual maturity and various aspects of egg laying performance. Subsequently, as most of the reported studies on thyroid and adrenal hormone status in different avian species were restricted to the sexually mature adult phase, the above study suggested some subtle favourable influence of HPR or HPO in the growing pullets.

It becomes evident from previous studies that both photoperiodic manipulations (representing an exogenous change) (Dandekar, 1998) and, manipulation of the adrenocortical status (representing an endogenous change) (chapter 2) in the sexually immature growing phase of the domestic hen, have potential effects on attainment of sexual maturity and various aspects of laying performance. The aim of this investigation was to comprehend the combined effect of either HPR or HPO and long photoperiod (LP), up to 90 days of age in RIR pullets, on attainment of sexual maturity and various facets of egg laying performance. Moreover, a similar experimental schedule was also employed in adult hens of 72 weeks of age for one month to evaluate the impact on the second cycle of lay.

MATERIALS AND METHODS:

As detailed in chapter 1

RESULTS:

Body weight and duration of egg laying : (Table 1 a & b) (fig. 1 and 2a).

Both the HPR and HPO hens weighed heavier than the control hens throughout, except at 60 days. Comparatively, the HPO hens weighed heavier than even the HPR ones. At 180 days, the HPR and HPO hens weighed heavier than the control birds by 7.5% and 15% respectively. All the three groups of hens showed maximal growth rate between 90-120 days. The control birds, initiated egg laying by 206 days (approximately 7 months), while the HPR and HPO hens initiated the same by 193 and 130 days respectively (approximately 6.5 and 4.3 months) respectively. The termination of egg laying occurred at 512, 555 and 418 days respectively in the three groups with an effective period of lay of 306 days in control hens, 362 days in the HPR hens and only 288 days in the HPO hens.

Number and weight of eggs and rate of lay : (Table 2 a & b) (fig. 2b)

Both the HPR and HPO hens laid significantly more number of eggs (181 and 161 respectively) than the control hens (156 eggs). The number of small eggs (<40gms) laid by the control, HPR and HPO birds were 8, 11 and 17 eggs/hen respectively and, the effective number of eggs calculated by subtracting the small eggs from the total yield was 148, 170 and 144 eggs/hen respectively (fig. 2b). Overall average rate of lay was, 0.51 eggs/day with an oviposition interval of 47 hrs in the control hens, 0.50 eggs/day with an oviposition interval of 48 hrs in the HPR hens and, 0.56 eggs/day with an oviposition interval of 43 hrs in the HPO hens. The average weight of eggs laid by the HPO hens was slightly more (48.7 gms), while that of HPR and control hens was quite similar (48.0 and 47.8 gms).

Monthly variations in the first lay : (Table 3 a,b,c) (fig 3, 4a,b)

The mean monthly egg yield was maximal in the second month in HPO hens (73%), in second and third months in HPR hens (66 & 67%) and during all the three months in control hens (77,73 & 72%). The control and HPO birds gave an yield of 60% or above, for the first four months while, the HPR hens gave such a yield throughout the first six months. The gradual decline in egg production was more markedly pronounced in the control hens while it was slowest in the HPR hens. The HPO hens showing an intermediary rate of decline, ceased laying totally after ten months. Both the control and HPO hens attained 50% egg production by 16th week while, the HPR hens attained the same slightly later at 19.4 weeks. The greatest mean monthly clutch size was 3.54 and 3.52 in control and HPR hens respectively during the second month, while, it was 4.71 in the HPO hens (fig. 4a,b). The distribution of the mean monthly number of clutches of various sizes during the laying period (table 4) shows that, a clutch of 6 eggs was quite common in the first three months in the HPO hens. Though less common, the same occurred in the HPR hens during the first two months and in the control hens only during the second month. Even a clutch of five was more common in the HPO hens as compared to HPR and control hens during the third month. The maximum mean monthly rate of lay was, 0.72 eggs/day in the second and third month in the control hens with an egg interval of 32.8 hrs, 0.67 eggs/day during the third month in the HPR hens with an egg interval of 35.2 hrs and, 0.73 eggs/day during the second and third month in the HPO hens with an egg interval of 32.6 hrs. Taking at least 12 eggs as minimal effective lay, the minimal rate of lay was 0.40 eggs/day with an egg interval of 59.7 hrs in the control birds, 0.46 eggs/day with an egg interval of 53.3 hrs in the HPR birds and 0.40eggs/day with an egg interval of 60hrs during the eighth month(table5).

Table 1 a. Body weight gain upto 180 days (6 months) in HPR and HPO pullets under LP.

	30 days	60 days	90 days	120 days	150 days	180 days
Control	120.0 ±4.08	386.66 ±4.71	610.10 ±6.12	916.0 ±13.8	1075.0 ±19.07	1170.1 ±15.39
HPR	130.0 ±10.8	317.15*** ±7.40	620.0 ±8.94	985.8*** ±7.11	1141.6* ±12.92	1258.3*** ±12.50
HPO	150.0** ±7.07	360.0*** ±5.09	627.5* ±26.11	1040.9** ±14.09	1208.5*** ±15.08	1350.4*** ±14.19

Values : Mean ± SE, n=12 ,* P<.05, **P<.005, ***P<.0005.

Table 1 b. Age at which initiation and termination of egg laying occured in HPR and HPO birds under LP.

	Initiation	Termination	Effective days of lay
Control	206.68 ±3.98	512.32 ±4.85	306.21 ±4.11
HPR	193.33* ±4.08	555.12*** ±3.99	362.66*** ±4.19
HPO	130.09*** ±3.60	418.29*** ±3.39	288.05** ±3.16

Values : Mean ± SE, n=12 ,* P<.05, **P<.005, ***P<.0005.

Table **2 a.** Laying performance of first lay ofHPR and HPO birds under **LP**.

	Total no. of eggs/hen	Total no. of small eggs/hen		Total number of effective eggs/hen	Rate of lay	
		no.	%		eggs/hen/ day	mean oviposition interval in hrs
C	156.71 ±4.01	8.3 ±.87	5.1	148.41 ±3.67	0.50	47
HPR	181.33*** ±3.89	11.6* ±1.12	6.0	170.33** ±2.98	0.50	48
HPO	161.02 ±5.23	17.0*** ±1.20	10.5	144.02 ±3.54	0.55	43

Values : Mean ± SE, n=12 ,* P<.05, **P<.005, ***P<.0005.

Table 2 **b.** Mean monthly and average egg weight of HPR and HPO birds under **LP**.

Period of lay (in months)	Mean monthly egg weights		
	Control	HPR	HPO
weight of first egg	37.0	38.48	44.71
1	43.61 ±5.21	44.43 ± 4.3	44.71 ±4.66
2	45.42 ±2.18	45.67 ± 3.7	46.67 ±4.21
3	46.56 ±2.75	46.92 ±3.22	46.83 ±3.18
4	45.30 ±2.29	47.67 ± 3.04	47.34 ±2.96
5	46.39 ±2.80	47.41 ± 2.77	47.62 ±2.61
6	45.17 ±4.09	46.83 ± 2.67	46.79 ±2.38
7	46.96 ±3.40	48.81 ± 2.26	48.81 ±2.17
8	48.14 ±3.10	48.92 ± 3.19	50.27 ±3.41
9	49.04 ±3.42	48.81 ±2.08	50.93 ±2.81
10	50.44 ±1.88	50.23 ±3.94	52.23 ± 2.18
11	-----	51.37 ±3.01	-----
12	-----	51.74 ±2.19	-----
Av. egg weight	47.81 ±4.01	48.03 ±5.67	48.78 ± 5.91

Values : Mean ±SE

Table 5. Average monthly rate of egg laying in HPR and HPO birds under LP.

	eggs/ day			mean oviposition interval (in hrs)		
	C	HPR	HPO	C	HPR	HPO
1	0.71	0.62	0.67	33.6	38.4	35.2
2	0.72	0.66	0.73	32.8	36.0	32.6
3	0.72	0.67	0.73	32.8	35.28	32.6
4	0.62	0.65	0.61	38.6	36.4	39.1
5	0.50	0.63	0.55	47.04	37.6	43.2
6	0.55	0.61	0.54	42.96	39.1	43.9
7	0.38	0.56	0.50	61.9	42.2	48.0
8	0.40	0.46	0.40	59.72	51.3	60.0
9	0.31	0.37	0.37	76.3	63.6	63.3
10	0.16	0.31	0.21	143.0	77.0	108
11	0.03	0.24	----	699.3	97.6	----
12	-----	0.16	----	-----	144	----

Values : Mean

Table 3. Average total number of eggs per month (A), average number of clutches per month (B) and average monthly clutch size (C) in HPR and HPO birds under **LP**.

A

	1	2	3	4	5	6	7	8	9	10	11	12
C	21.33 ±0.5	21.82 ±0.6	21.67 ±0.3	18.60 ±1.1	15.28 ±0.4	16.70 ±0.3	11.59 ±0.4	12.01 ±0.2	9.41 ±0.7	5.03 ±0.8	1.02 ±0.6	---
HPR	18.66*** ±0.5	20.0 ±1.5	20.33 ±1.5	19.66 ±0.5	19.0* ±2.0	18.30 ±1.5	17.0*** ±0.7	14.0* ±0.8	11.31 ±1.2	9.33** ±0.7	7.37*** ±0.7	5.0 ±0.7
HPO	20.33* ±0.5	22.0 ±1.7	22.0 ±1.3	18.33 ±0.7	16.66 ±0.9	16.35 ±0.5	15.0* ±1.9	12.0 ±1.5	11.33* ±0.7	6.40 ±0.3	---	---

B

month	1	2	3	4	5	6	7	8	9	10	11	12
C	7.01 ±.03	6.66 ±.57	6.66 ±.57	7.01 ±1.01	8.33 ±1.15	7.66 ±1.52	9.66 ±.57	9.33 ±.57	9.66 ±.57	7.66 ±.57	1.00 ±.004	---
HPR	9.70** ±.66	5.81 ±.57	7.03 ±.93	7.92 ±.87	6.07* ±.25	9.41 ±.33	9.81 ±.73	8.03 ±.64	6.33* ±1.04	10.27* ±1.01	7.30*** ±.71	5.00 ±.28
HPO	7.44 ±.27	4.80* ±.44	5.12 ±.74	8.89* ±.23	9.27 ±.40	10.03 ±.07	9.19 ±.22	9.33 ±1.15	9.42 ±.98	6.44 ±.76	---	---

C

month	1	2	3	4	5	6	7	8	9	10	11	12
C	3.04 ±.08	3.54 ±.21	3.26 ±.34	2.69 ±.55	1.81 ±.28	2.20 ±.34	1.20 ±.10	1.27 ±.11	0.96 ±.05	0.65 ±.05	0.25 ±.001	---
HPR	1.99* ±.53	3.52 ±.37	2.90 ±.51	2.56 ±.87	3.16* ±.45	1.96 ±.23	1.72* ±.17	1.55 ±.21	1.41** ±.14	1.06*** ±.11	0.99*** ±.02	1.00 ±.07
HPO	3.04 ±.65	4.71 ±.71	4.40 ±.76	2.11 ±.39	1.78 ±.22	1.67 ±.27	1.60* ±.29	1.28 ±.22	1.17* ±.08	1.01*** ±.006	---	---

Values : Mean ± SE, n=12 ,* $P<.05$, **$P<.005$, ***$P<.0005$.

Table **4** Mean monthly clutches of various sizes of eggs of HPR and HPO birds under **LP.**

Number of clutches of various sizes	1 m			2 m			3 m			4 m			5m			6 m		
	C	HPR	HPO	C	HPR	HPO	C	HPR	HPO	C	HPR	HPO	C	HPR	HPO	C	HPR	HPO
1	---	4.69 ±.22	2.40 ±.11	---	1.02 ±.04	---	0.33 ±.09	0.66^{b} ±.02	0.30 ±.04	0.33 ±.10	0.60^{a} ±.02	2.11^{c} ±.30	1.66 ±.58	---	5.27^{c} ±.54	3.66 ±1.3	4.00 ±.23	5.36 ±.16
2	3.33 ±1.1	2.41 ±.11	1.03^{a} ±.08	0.33 ±.08	1.6^{b} ±.33	---	2.01 ±.69	2.19 ±.22	1.22 ±.11	5.66 ±.08	2.89^{c} ±.42	4.88 ±.54	4.33 ±1.5	2.61 ±.47	2.65 ±.32	4.66 ±1.6	3.25 ±.13	3.56 ±.42
3	1.05 ±.69	0.66 ±.08	1.03 ±.05	3.00 ±.92	2.02 ±.57	0.33^{a} ±.04	1.66 ±.54	2.47 ±.75	0.30^{a} ±.22	2.33 ±.57	3.03 ±.42	2.03 ±.21	1.33 ±.57	1.89 ±.22	1.41 ±.21	0.66 ±.17	1.09 ±.21	1.00 ±.04
4	1.66 ±.52	0.66^{a} ±.08	0.33^{a} ±.01	2.66 ±.57	0.66^{b} ±.08	1.35^{a} ±.08	3.01 ±.68	1.52^{a} ±.33	0.33^{b} ±.02	---	1.00 ±.89	0.33 ±.02	0.33 ±.07	1.02^{c} ±.11	0.39 ±.11	0.66 ±.20	1.20 ±.33	0.39 ±.08
5	0.66 ±.08	0.63 ±.03	1.05^{c} ±.03	0.37 ±.14	---	1.39 ±.04	---	0.33 ±.05	2.20 ±.11	---	0.30 ±.04	---	---	1.02 ±.11	---	---	1.20 ±.33	0.30 ±.03
6	---	0.33 ±.02	1.03 ±.04	0.66 ±.12	0.71 ±.03	1.30^{c} ±.32	---	---	1.69 ±.08	---	---	---	---	---	---	---	---	---
7	---	---	---	---	---	0.33 ±.13	---	---	---	---	---	---	---	---	---	---	---	---

Values : Mean ± SE, n=12 , a-$P<.05$, b-$P<.005$, c-$P<.0005$.

contd...........

Number of clutches	7 m			8 m			9m			10m			11m			12m		
	C	HPR	HPO	C	HPR	HPO	C	HPR	HPO	C	HPR	HPO	C	HPR	HPO	C	HPR	HPO
1	7.42 ±1.6	3.86[a] ±.46	6.02 ±1.0	7.33 ±1.5	4.51 ±.81	6.75 ±.20	6.33 ±.57	5.03 ±1.1	8.12[a] ±.28	3.00 ±.28	9.01[c] ±1.0	6.77[c] ±0.9	1.00 ±.09	7.59[c] ±.87	---	---	5.33 ±.91	---
2	2.14 ±.93	5.12[a] ±.44	2.67 ±.56	2.04 ±.79	4.12[a] ±.57	2.45 ±.35	1.01 ±.43	1.79 ±.21	2.17[a] ±.22	1.00 ±.03	1.48 ±.51	---	---	---	---	---	---	---
3	---	1.23 ±.02	0.89 ±.11	0.33 ±.07	0.33 ±.04	---	0.33 ±.06	1.00 ±.03	---	---	---	---	---	---	--	---	---	---
4	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
5	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
6	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Values : Mean ± SE, n=12 ,a-P<.05, b-P<.005, c-P<.0005.

Table 6. .Second cycle laying performance of HPR and HPO birds under **LP**.

	Total number of eggs laid/bird	**Av. Egg weight in gms**	**Average period of lay**	**Overall rate of lay/bird/month**
Control	79.39 ±4.74	50.68 ± .30	10 months	7.9 ±.009
HPR	52.22 ±1.91***	51.3 ± .95	10 months	5.2 ±.05***
HPO	67.11 ±2.19***	51.98 ± .55	10 months	6.7 ±.04***

Values : Mean ± SE, n=12 ,* $P<.05$, **$P<.005$, ***$P<.0005$.

Table 7. Comparative projection of total amount of feed consumed/bird till the end of lay and feed/dozen eggs.

	Total no. of days	Total no. of eggs	Feed consumed (Kg/doz.eggs)	Total feed consumed (Kg)
Govt. Poultry record	530.00	178	4.28	63.50
Control	512.32 ±4.85	156.71 ±4.01	3.73 ±.04	48.75 ±.07
HPR	555.12 ±3.99***	181.33 ±3.89***	3.57 ±.06*	53.94 ±.04***
HPO	418.29 ±3.39***	161.02 ±5.23	2.46 ±.04***	33.09 ±.05***

Values : Mean ± SE, n=12 ,* $P<.05$, **$P<.005$, ***$P<.0005$.

Fig. 1. Body weight gain upto 180 days (6 months) of HPR and HPO hens under LP.

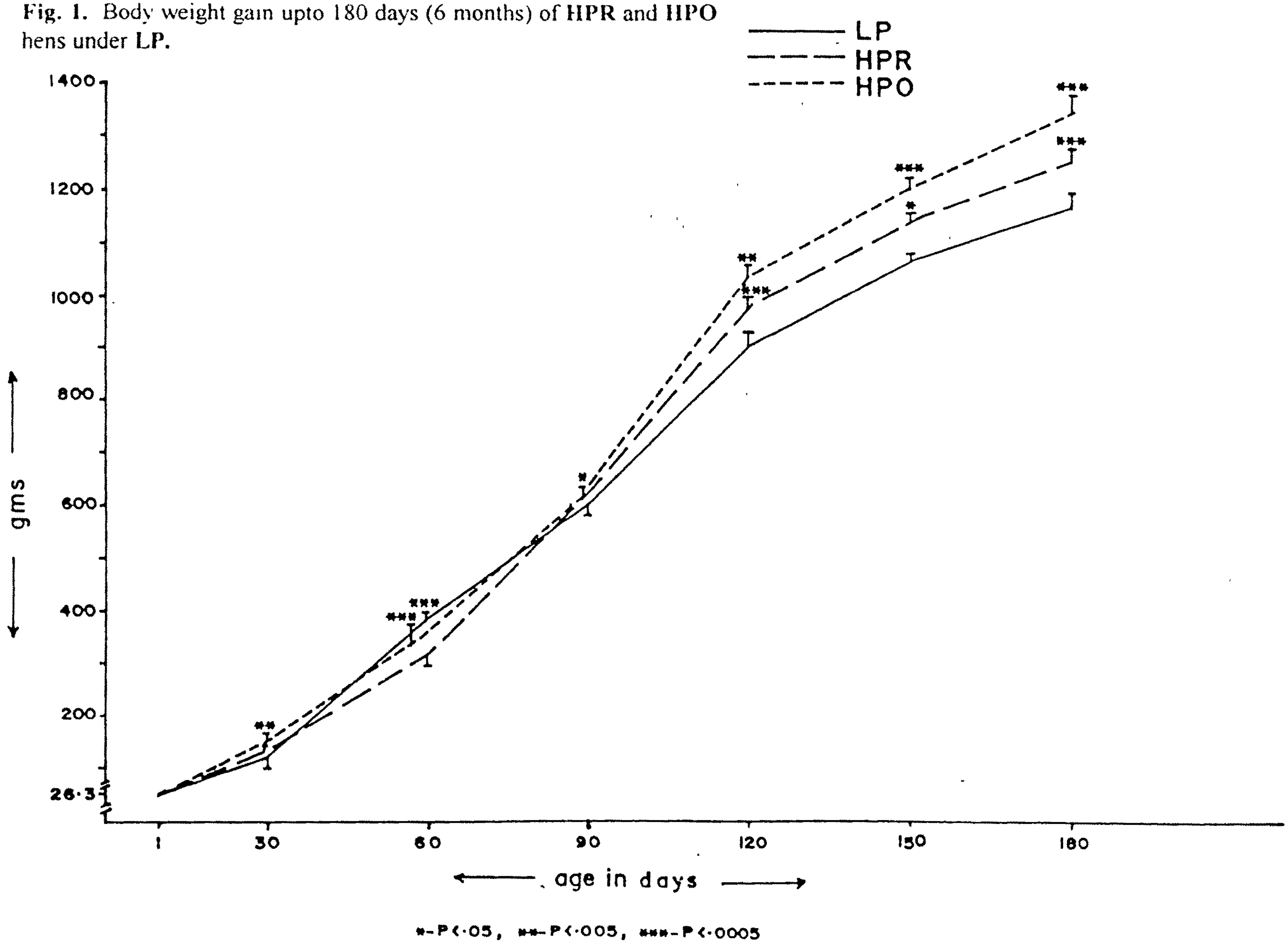


Fig. 2. Figure showing initiation, termination and effective days of egg laying (A) and egg laying performance (B), of HPR and HPO hens under LP

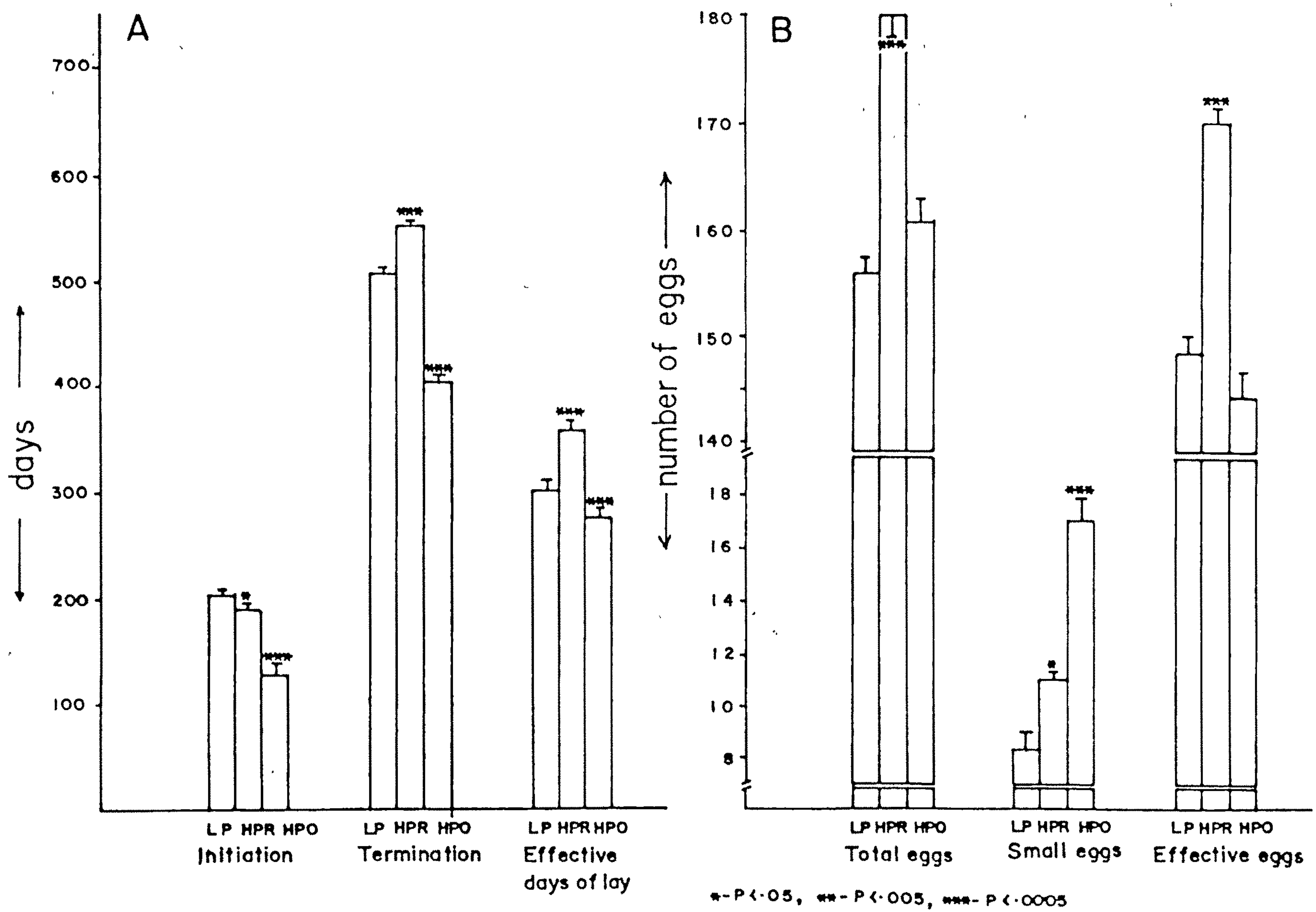


Fig. 3a. Number of eggs/hen/month laid by **HPR** and **HPO** hens under **LP**.

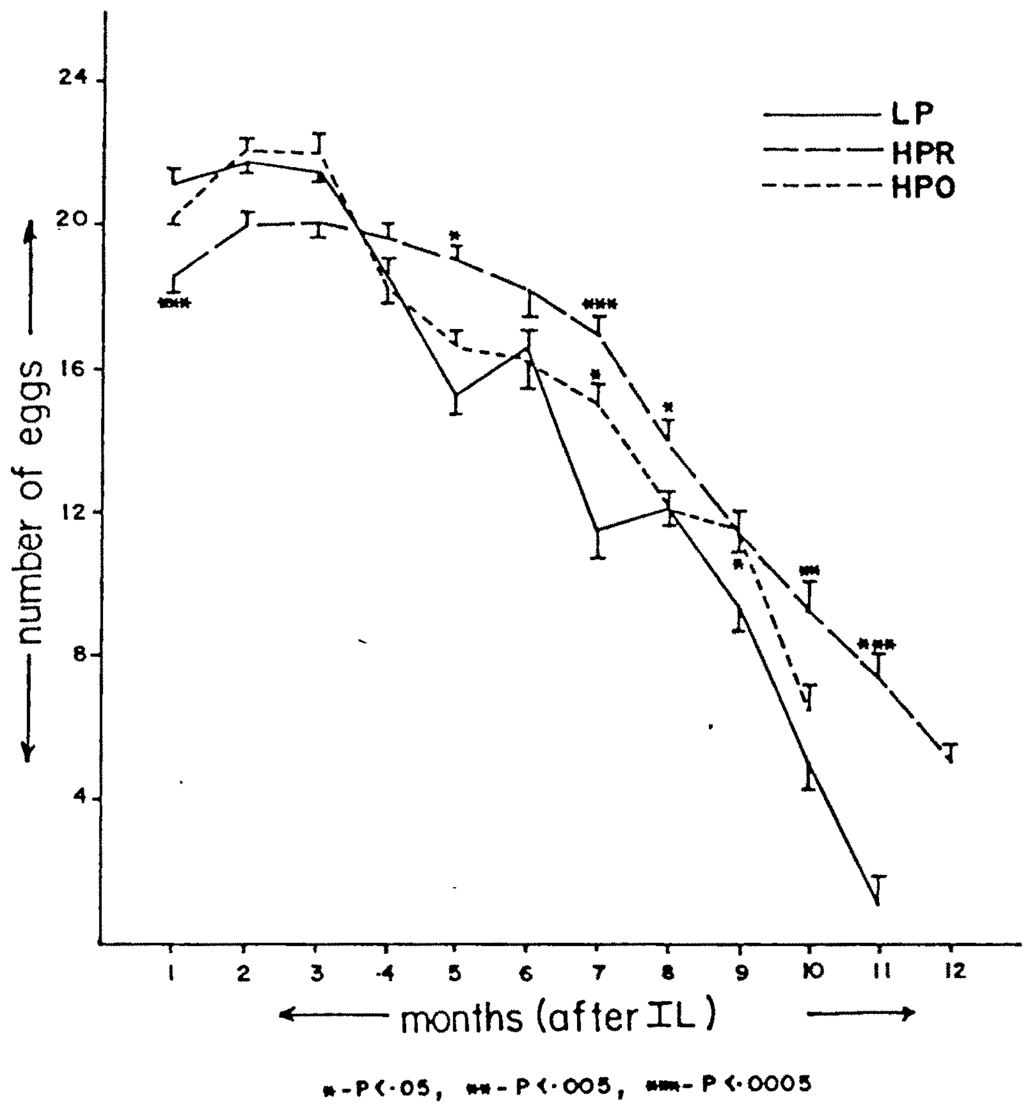
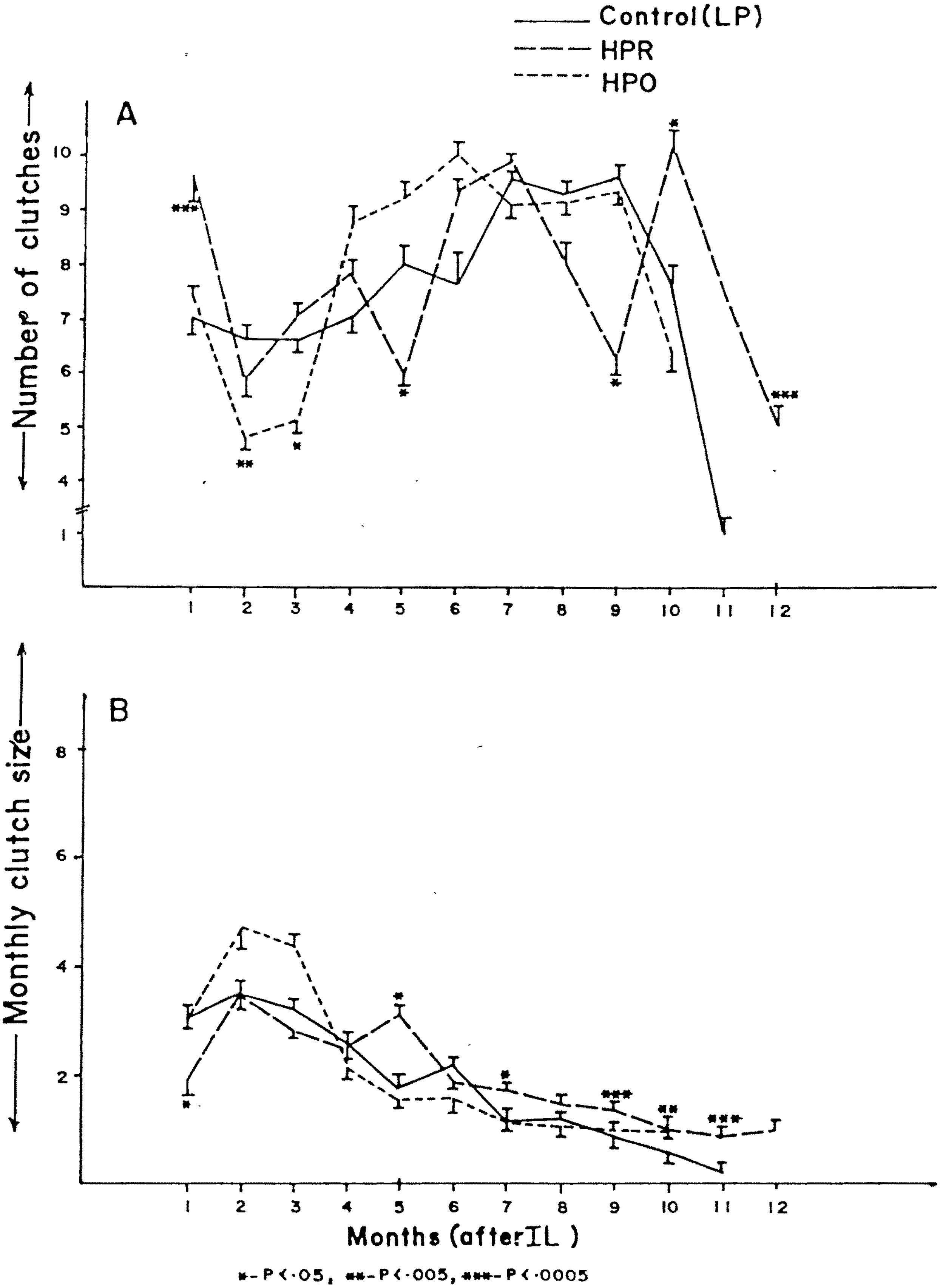


Fig. 3b. Average number of clutches and clutch size laid by **HPR** and **HPO** hens under **LP.**



The data on the second cycle lay of hens subjected to HPR / HPO between 72-76 weeks of age and that of the control hens is represented in table 6. Whereas the control hens laid 79 eggs at a rate of 7.9 eggs/month, the HPR hens laid a total of 52 eggs at a monthly rate of 5.2 eggs and, the HPO birds laid a total of 67 eggs at a rate of 6.7 eggs/month for the same duration of an identical 10 months period of lay. The yield of eggs in both the HPR and HPO hens was significantly lower than the control hens. The mean egg weight was slightly more in the HPR group and slightly less in HPO group as compared to the controls.

Discussion :

A previous study on Indian RIR breed involving rearing of pullets under LP followed by shifting to natural photoperiod, amounting to a step down photic schedule, as employed in the present study, had shown delay in initiation of egg laying and lesser yield of eggs but, a positive response in the form of a superior rate of lay with lesser number of days of laying (see chapter 2). In another study involving induction of HPR or HPO in RIR pullets upto 90 days of age, also demonstrated some subtle but definite influence of altered corticosterone levels on some aspects of the first laying cycle (see chapter 3). The present study, involving a combination of the above two experimental schedules, has revealed significant modulatory interactions of both photoperiod and adrenocortical status on the laying performance of the Indian RIR hens. The initiation of lay which occurred at 216 days in the control group, represents a delay by 28 days compared to a normal photoperiodic schedule as reported earlier (see chapter 2). Both HPR and HPO seem to have a significant obviating effect on the LP induced delay as, the former condition advanced egg laying by 13 days and, the latter condition by as much as 76 days. Infact, the initiation of egg laying (IL) which occurred at 130 days in the HPO group represents a delay of only 10 days compared to the initiation at 120 days in pullets exposed to a short photoperiod (Dandekar, 1998) and, a significant advancement by 48 days, as compared to the initiation at 178 days in pullets maintained under normal photoperiodic condition (Dandekar, 1998; chapter 3). The effective period of egg laying was significantly longer in HPR hens by 56 days, both due to an early initiation by 13 days as well as a delay in termination of laying by 43 days. However, in the HPO hens, the termination of egg laying also occurred significantly earlier by 94 days, resulting in a reduced effective period of lay by 18 days. Since the duration of lay of 306 days in the control birds itself represents a reduction by 46 days induced by a step down photoperiod compared to birds reared under normal photoperiodic conditions (Dandekar, 1998; chapters 2 and 3), the presently observed reduced duration of lay in the HPO birds, represents a cumulative influence of HPO status and long photoperiod. The total yield of 156 eggs/hen during the first cycle of lay in the control birds, which represents a decrement by 12 eggs/hen compared to the yield of 168 eggs under natural photoperiodic conditions (Dandekar, 1998; see chapter 2), was almost nullified by HPO condition as the difference was reduced to only 7 eggs and, even bettered in the HPR condition by 13 eggs/hen. Obviously, both HPR and HPO in the growing phase have a nullifying influence over the effect of a step-down photoperiod, with the HPR condition in fact having a positive favourable influence along with, LP as the yield of eggs under LP+HPR is significantly more than that obtained under HPR alone (see chapter 3). Pertinently, HPR was also documented to have an additive influence over that of short photoperiod induced favourable response (Dandakar, 1998). In terms of total number of eggs, as against a reduction of 8% in LP birds as compared to NLD birds, there was an improvement by 8% in LP+HPR birds compared to NLD (Dandekar, 1998; chapter 2), resulting in an overall 16% improvement in LP+HPR hens compared to LP hens. However, the overall rate of lay in terms of eggs/hen/day as well as the mean oviposition interval which were 9% more and 6% less respectively under LP condition compared to NLD (Dandekar, 1998; chapter 2), were reduced by 3% and increased by 2% respectively under LP+HPR condition. Apparently, HPR condition has a marginal negative effect on the favourable influence of LP on rate of lay and oviposition interval. In contrast, though the HPO condition only partially overcame the negative influence of LP on percentage egg yield (3.2% increase over LP and only 4% less than NLD as against 7% less under LP), the rate of lay and the oviposition interval were both significantly improved over that of LP. A comparison with NLD reveals that as against 8.5% increase in eggs/day yield under LP, it was 19% increase under LP+HPO and, as against 6% decrease in oviposition interval under LP, it was 14% less under LP+HPO. Inferably, HPO condition has an additive influence over LP on rate of lay and oviposition interval by 10% and 8.5% respectively. The number of small eggs (<40 gms) was slightly more under both HPR and HPO conditions (6% and 10% respectively) compared to LP (5%) but, not more than NLD (10%), with the result that the percentage of effective eggs remained the same as that of the total number of eggs.

A comparison of the growth kinetics of the three groups of birds reveals that, both HPR and HPO birds weighed heavier by 7.5% and 15% respectively than the LP control birds at 180 days and this trend of increase in body weight became clearly manifested in both the groups only from 90 days onwards. Such an increase in body weight under both HPR and HPO conditions was also observed under short photoperiod (Dandekar, 1998) but, not under NLD as, only the HPO birds showed a marginally increased body weight (see chapter 3). It is inferable from these observations that, there is a differential effect of HPR or HPO status on increase in body weight during the growth phase in relation to photoperiod. Whereas, either under SP or LP, there is a favourable influence of both HPR and HPO on weight gain, under NLD, HPR has a negative influence and HPO a positive influence. Generally, both HPR and HPO have been reported to have a retardatory influence on body weight in adult domestic fowl (Davison *et al.*, 1979; Harvey and Scanes, 1979; Gross *et al.*, 1980; Bartov, 1982; Davison *et al.*, 1983; Saddoun *et al.*, 1987; Brake *et al.*, 1988), as well as in white leghorn chicks (Joseph and Ramachandran, 1992). In this respect, the presently recorded increase in body weight under both conditions is at variance from the above reports and, the only rational explanation may be sought in the inherent mode of treatment and the degree of hyper. or hypocorticalism as, the present study involves continuous release of the responsible agents in low doses leading to mild HPR or HPO (see chapters 9 and 10), as against acute or chronic injections in the above studies. Obviously, treatment schedules in terms of continuous release or timed injections and, the degree of HPR or HPO may have a greater bearing on growth and body weight in the domestic fowl. But, how similar experimental schedules and dosage of agents, bring about differential effects under different photic schedules, is enigmatic and finds no justifiable explanation at this juncture. In terms of growth rate, all the three groups of birds depicted maximal rate between 90 and 120 days. The increased growth rate and the resultant ultimate body weight shown by both the HPR and HPO birds cannot be related to either food intake or fattening, as all the groups of birds were given fixed amount of timed rationed diet and also, there was no evidence of fat deposition. This would suggest a better anabolic response in both HPR and HPO pullets reared under LP.

Weight of the first egg at IL, was significantly more in the HPO birds (by 3 gms) and, marginally more in the HPR birds (by 1 gms). This difference in egg weight was persistent and manifested throughout the period of lay as recorded by the mean monthly weights. The egg weight recorded for LP control birds, is greater than that in NLD birds (see chapter 2) suggesting a favourable influence of LP on egg weight. Apparently, HPO has an additive influence on egg weight over and above that induced by LP and, a nullifying influence on the negative effect of SP on egg weight (Dandekar, 1998). Analysis of the entire first cycle of lay on a monthly basis reveals that, 50% egg production (EP) was delayed in the HPR group (19.4 weeks) as compared to the control group (16 weeks) while, in the HPO group, 50% productivity was attained at the same period as in the controls (16.3 weeks). Previously, it was reported that step-up photoperiod (SP) could advance 50% egg yield by two weeks from 21weeks to 19 weeks compared to NLD (Dandekar, 1998). The presently observed attainment of 50% EP by the 16^{th} week in the control group, as also reported earlier (see chapter 2), suggest a further advancement under a step-down photoperiod. Evidently, HPR has a negative effect on the favourable influence of LP as it delays attainment of 50% EP by almost three weeks and, infact the LP+HPR birds are more comparable to SP group of birds (Dandekar, 1998). But HPO has no modulatory influence on the age of attainment of 50% egg productivity, effected by LP.

A comparison of the monthly yield of eggs shows that, the HPR hens have a lower laying performance during the first four months compared to the control and HPO hens, while from the fifth month onwards, the laying performance is much superior to that of control hens besides, prolongation of the laying period by one more month (fig. 3). In fact, even the HPO birds show a better laying performance from the fifth month onwards. However, the HPO hens recorded a slightly lesser net egg output, mainly due to a sudden cessation of egg laying at 10 months. Compared to control birds, the egg yield at 10 months was significantly more in the HPO birds. A similar favourable influence of HPO resulting in better egg yield during the first eight months of lay was also observed under NLD conditions (chapter 3). In the above study, the net lower yield in HPO hens was accredited to a sudden precipitous steep decline in egg yield during the last three months, while in the present study, it is essentially due to an abridged duration of lay. It is surmisable from these observations that, HPO has by as yet unknown reasons, a favourable influence on ovarian functions in the initial periods under NLD and LP schedules. However, HPO has an overall unfavourable influence on ovarian functions under SP (Dandekar, 1998). The mean monthly clutch size and the number of clutches, show a generalized reciprocal relationship in all the three groups. Whereas, HPR did not have any significant influence on these parameters except for a favourable influence in the last few months of lay, HPO had a definite favourable influence in the form of increased clutch size in the first three months and, a steady mean clutch size during the last four months of lay. Clearly, functional differences in the adrenocortical status during the rearing period, has definite influences on adult functional features of the ovary, reflected in clutch size and number of clutches. This is also indicated in the observed range of rate of lay and oviposition interval in the

HPR and HPO groups. While both the rate of lay as well as the oviposition interval were better throughout in HPO birds, in the case of HPR birds they were poor in the initial periods and better in the later periods compared to the controls. The data on the monthly distribution of the number of clutches of various sizes shows a consistent lay of clutches of six eggs during the first three months in HPO birds. Only 60-70% of the control and HPR hens laid a single clutch of six eggs, only during the second month or the second and third months respectively. Previously, it was reported that HPO tended to support lay of clutches of six eggs even under SP schedule. Taken together, it suggests that HPO in the immature pullets, does have some influence in modulating ovarian functions favouring long sequence lay in the early months under either a step-up or a step-down photic schedule, more significantly in the latter. A valid explanation for the underlying cause which may involve interactions between adrenal corticoid and the ovary remains elusive at this juncture.

The data on feed consumption projected in table 7 clearly reveals that, the overall per bird feed consumption for the entire period of maintenance is significantly more in the HPR group and less in the HPO group. The total feed consumption by the LP control birds (48.75 kg/bird) is significantly more than birds subjected to SP (46.4 kg/bird) but significantly less than birds maintained under NLD (51.18 kg/bird) as reported previously (Dandekar, 1998; chapter 2). However, the feed consumption per dozen eggs, is similar in both HPR and control birds (marginally less in HPR) and, significantly less in the HPO birds. Whereas the total feed consumption is the reflection of the total period of maintenance, the feed/dozen eggs is the indication of rate of lay, which is predictably much better in the HPO birds. Apparently, both HPR and HPO along with long photic schedule, have definite favourable influence on overall poultry economy and, on a comparative basis, HPO is more meaningful and significant when considered in terms of cost analysis on a large flock of birds as in a poultry farm.

In terms of second cycle of lay, the yield of 79 eggs/hen in adult hens (72-76 weeks of age) exposed to L:D 18:6, was shown to be significantly less than the yield of hens maintained under NLD (LD 12:12; see chapter 2). The present study shows that, both HPR and HPO along with LP have a further depressive effect on the second cycle of lay, as the total yield of eggs was significantly less, more pronouncedly in HPR birds. Evidently, superimposition of either HPR and HPO on LP has a cumulative depressive effect on the second cycle of lay. This is in distinct contrast to a favourable influence of HPR under L:D 12:12 recorded earlier (see chapter 3). Taken together it would suggest, differential interactions between adrenocortical status and photoperiod in adult hens with consequent effects on the second cycle of lay. The intricacies underlying these interactions are enigmatic and, remains at best, a matter of conjunction, since, the dosage of corticosterone and metyrapone used remained the same as that used in the pullets. It is a matter of conjecture as to whether an increased dosage of these agents resulting in greater perturbations in CORT levels, would have any favourable consequences and hence meriting experimental evaluations. In conclusion, it can be highlighted that, both HPR and HPO along with exposure to long photic schedule in the immature stage, have a definite favourable influences on egg laying performance and that, HPO is a more economically feasible approach.