NOTE: USE OF PARAAMINOBENZOIC ACID TO IMPROVE YIELD OF SILKWORM (*Bombyx mori* L.)

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ABSTRACT

Paraaminobenzoic acid (PABA) at 50, 100, 200 and 400 ppm concentrations were administered to third instar larvae of silkworm (*Bombyx mori* L.) by leaf dip method. Results showed marked improvement of the silk percentage at low concentrations of 50-100 ppm. The use of appropriate PABA concentrations in commercial silkworm rearing is thus recommended.

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KEY WORDS: *Bombyx mori* L. . Paraaminobenzoic acid (PABA). Leaf dip method. Silk yield.

Silkworm (*Bombyx mori* L.) is a useful insect to mankind since it produces large amounts of silk during its metamorphosis from larva to pupa. Several attempts have been made to increase silk yield by employing methods like selection breeding and mutation breeding but with little success.

In plants, growth regulators are extensively used to promote growth and increase yield (Singh et al.,

1978; Raza, 1978; Castro Paulo et al., 1979; Nelson and Sharples, 1980; Bellucci et al., 1982; Wample and Elaine, 1983; Datta and Datta, 1983; and Agarwal, 1984). However, no information on the use of growth regulators to improve the yield of animal products is available.

In silkworm; Akai (1971), Akai and Kobayashi (1971), and Kobari and Akai (1978, 1979) showed improved silk yield when larvae of said insect were treated with juvenile hormone (JH) manta. Likewise, Krishnaswami et al. (1980) and Shimada et al. (1981) also obtained similar results using JH analog ZR 512 and a mixture of methoprene and JH, respectively. Consequently, they recommended the use of these chemicals in silkworm rearing. Considering the paucity of information on the use of chemical growth regulators in improving silk yield and the role of JH in silkworm rearing, the present study was undertaken with the hope of increasing silk yield using paraaminobenzoic acid (PABA).

Larvae which came from disease-free eggs of the multi-voltine Pure Mysore and the bivoltine Kalimpong-A races of silkworm (*Bombyx mori* L.) were reared separately and maintained up to second molt with normal mulberry leaves as feed. During the third instar, 600 healthy larvae of approximately equal weight were selected from each of the two races. These were divided into six groups of 100 worms each. The larvae were then separately reared and the growth regulator was administered by leaf dip method. The treatments used were as follows: normal mulberry leaves, mulberry leaves soaked in distilled water and air dried, mulberry leaves soaked in 50 ppm PABA and air dried, mulberry leaves soaked in 100 ppm PABA and air dried, mulberry leaves soaked in 200 ppm PABA and air dried, and mulberry leaves soaked in 400 ppm PABA and air dried. The first two treatments represented the controls. The same pattern of feeding was continued up to spinning stage. Cocoons obtained from the different groups were assessed for their economic traits like cocoon weight, shell weight and shell ratio at a laboratory temperature of 25 ± 1°C. Percentage increase in larval body weight was calculated by dividing actual increase in body weight by control body weight and multiplying the quotient by 100. Similarly, percentage increase in shell ratio was calculated by dividing actual increase in shell ratio by control shell ratio and multiplying the quotient by 100.

Table 1 shows the effect of different concentrations of PABA fed to larvae on the economic traits of Kalimpong-A and Pure Mysore

Table 1. Effect of different PABA concentrations on the economic traits of Kalimpong-A and Pure Mysore races of silkworm.

Treatment [Race/PABA conc. (ppm)]	Fifth Instar Larval Wt. (g)	Actual Wt. Increase Over Control B (g)	% Increase Over Control B	Larval Duration (hrs)	Single Cocoon Weight (g)	Actual Wt. Increase Over Control B (g)	% Increase Over Control B	Single Shell Weight (g)	Shell Ratio (Silk Percentage)	Actual Improvement Over Control B (%)	% Improvement of Shell Ratio
Kalimpong-A											
0 (Control A)	33.6	—	—	624	1.982	—	—	0.323	16.29	—	—
0 (Control B)	33.4	—	—	624	1.970	—	—	0.320	16.24	—	—
50 ppm	42.1	8.7	26.05	634	1.925	-0.045	2.28	0.342	17.76	1.52	9.36
100 ppm	42.3	8.9	26.65	634	1.812	-0.158	-8.02	0.338	18.65	2.41	14.84
200 ppm	26.0	-7.4	-22.16	687	1.867	-0.103	5.23	0.285	15.26	-0.98	- 6.03
400 ppm	27.0	-6.4	-19.16	711	2.064	0.094	4.77	0.295	14.29	-1.95	-12.01
Pure Mysore											
0 (Control A)	18.2	—	—	667	0.910	—	—	0.088	9.67	—	—
0 (Control B)	18.3	—	—	667	0.910	—	—	0.090	9.89	—	—
50 ppm	19.3	1.0	5.46	677	0.989	0.079	8.68	0.100	10.11	0.22	2.22
100 ppm	20.3	2.0	10.93	677	1.148	0.238	26.15	0.153	13.32	3.43	34.68
200 ppm	20.3	2.0	10.93	721	0.940	0.030	3.30	0.081	8.61	-1.28	-12.94
400 ppm	21.4	3.1	16.94	721	0.820	-0.090	- 9.89	0.078	9.51	-0.38	- 3.84

races of silkworm. In Kalimpong-A, larvae fed with mulberry leaves soaked in 50 and 100 ppm of PABA increased their body weights during the fifth instar by 26.05 and 26.65% over that of control B, respectively. However, higher concentrations resulted in marked decrease in larval body weight since PABA is toxic to *B. mori* at high doses. In the Pure Mysore race, the larval body weight increased with increasing PABA concentration. The highest percentage increase of 16.93% was obtained at 400 ppm. PABA at high doses is probably less inhibiting to Pure Mysore than to Kalimpong-A since it increased cellular synthesis, hence also increased body weight of the former at 400 ppm. Higher body weight over the control was obtained by Krishnaswami et al. (1980) using 10 ppm of JH analog ZR 512 in acetone. However, they did not use concentrations other than 10 ppm.

Larval duration generally increased with increasing PABA concentration. At 50 and 100 ppm concentrations, larval duration of Kalimpong-A was longer by 10 hours over that of both controls and by 63 hours at 200 ppm concentration. At 400 ppm PABA, larval duration was lengthened by 87 hours. Similarly, larval duration at 50 and 100 ppm in Pure Mysore was prolonged by 10 hours, and by 54 hours at 200 and 400 ppm. Akai and Kobayashi (1971), and Krishnaswami et al. (1979) observed similar proportional increase in larval duration after feeding the larvae of few silkworm races with JH and their analogs. For molting or for pupation in insects, a proper dose of molting hormone is necessary. Otherwise, the larvae continue to grow. This suggests that feeding silkworm larvae with high concentration of PABA upsets the hormonal balance especially that of molting hormone, thus prolonging larval duration.

With regard to cocoon weight and silk percentage, improved values were obtained at different PABA concentrations in both races. The cocoon weight of Kalimpong-A was increased by 4.77% at 400 ppm while that of Pure Mysore was increased by 8.68, 26.15 and 3.30% at 50, 100 and 200 ppm, respectively. Increased biosynthesis of silk and cellular synthesis may be responsible for increased cocoon weight. Results show that cocoon weight was better enhanced by PABA treatment in Pure Mysore than in Kalimpong-A especially at low doses of 50 and 100 ppm. Increases in shell ratio of 2.22% in Pure Mysore and 9.36% in Kalimpong-A were observed at 50 ppm concentration; and increases of 34.68% in Pure Mysore and 14.84% in Kalimpong-A at 100 ppm of the growth regulator.

Perhaps, the growth regulator enhanced the synthesis of proteins in the silk glands as has also been suggested by Akai (1971), Murakoshi et al. (1972), and Aomori et al. (1977) who fed silkworm larvae with juvenile hormone on artificial diet. Nihmura et al. (1972), Akai and Kobayashi (1971), Akai et al. (1973, 1978), Muroga et al. (1975) and Kobari and

Akai (1978, 1979) also obtained similar results when they fed the larvae with normal mulberry leaves sprayed with juvenile hormone. Even topical application of juvenile hormone analog to silkworms increased their total silk yield (Krishnaswami et al., 1980).

Results indicate that PABA concentrations above 100 ppm generally do not improve the economic traits. High PABA concentrations may adversely affect larval body parts or the silk gland. Hence, the yield proportionally decreases with increased PABA concentration. Considering the commercial value of increased silk percentage, the use of PABA at low concentrations up to 100 ppm is recommended for commercial silkworm rearing.

LITERATURE CITED

AGARWAL, S.C. 1984. Effect of IAA and GA on akinete formation of *Pithophora oedogonia* (Mont) Wittrock. Cur. Sci. 53(4):217-218.

AKAI, H. 1971. Ultrastructure of fibroin in the silk gland of larval *Bombyx mori*. Exptl. Cell. Res. 69:219-223.

AKAI, H., KIGUEHI, K., KOBARI, Y. and SHIBUKAWA, A. 1978. Practical utilization of juvenoids for increasing silk production. Inst. of Organic and Physical Chemistry of Wrociew Tech. Univ. Scientific Paper No. 22, Conference 7. pp. 781-792.

AKAI, H., KIGUEHI, K. and MORI, K. 1973. The influence of juvenile hormone on the growth and metamorphosis of *Bombyx mori* larvae. Bull. Sericult. Exptl. Stn. 25:287-305.

AKAI, H. and KOBAYASHI, M. 1971. Induction of prolonged larval instar by JH in *Bombyx mori* L. (Lepidoptera: Bombycidae). Appl. Ent. Zool. 6:138-139.

AOMORI, S., OZAWA, Y. and NIHMURA, M. 1977. Timely administration of synthetic compound with ZH activity to silkworm larvae reared on artificial diet. J. Sericult. Sci. (Japan) 46:69-76.

BELLUCCI, S., KELLER, E.R. and SCHWENDINANN, F. 1982. Influence of growth regulator on development and yield components of the *Vicia faba*. 1. Effect of growth hormone on the yield component and the supply of the young fruit with carbon 14. Angew Bot. 56:35-54.

CASTRO PAULO, R.C., DEMETRIO, L.G.B. and MARISA, V.E. 1979. Action of growth regulator on *Chrysanthemum leucanthemum*. An ESC Super Agric "Luiz de Queiroz" Univ. Sao Paulo 36:67-76.

DATTA, S.K. and DATTA, K. 1983. Auxin-induced regeneration of forest tree, *Delbergia sisso* Roxb., through tissue culture. Cur. Sci. 52(9):434-436.

KOBARI, Y. and AKAI, H. 1978. Utilization of manta (synthetic compound of juvenile hormone activity) for silkworm rearing. J. Sericult. Sci. (Japan) 47:315-319.

KOBARI, Y. and AKAI, H. 1979. On quantitative increase of silk production by the administration of juvenile hormone (manta). J. Sericult. Sci. (Japan) 48:37-42.

KRISHNASWAMI, S., BENCHAMIN, K.V., GEETHADEVI, R.G. and RAGHURAM, R. 1980. Studies on the effect of juvenile hormone analog ZR 512 on silkworm. CSR & TI Annual Report. p. 54.

MUROGA, A., NAKAJIMA, M., AOMORI, S., OZAWA, Y. and NIHMURA, M. 1975. Utilization of the synthetic juvenile hormone analog to silkworm rearing on mulberry leaves. J. Sericult. Sci. (Japan) 44:267-273.

MURAKOSHI, S., CHENG, C.F. and TAMURA, S. 1972. Increase in silk production by silkworm *Bombyx mori* L. due to oral administration of juvenile hormone analog. Agric. Biol. Chem. 36:695-696.

NELSON, J.M. and SHARPLES, C.C. 1980. Effect of growth regulators on germination of a cucumber (*Cucumis sativus*) and other cucurbit seeds at suboptimal temperature. Hortscience 15:253-254.

NIHMURA, M., AOMORI, S., MORI, K. and MATSUI, M. 1972. Utilization of synthetic compound with juvenile hormone activity for silkworm rearing. Agric. Biol. Chem. 36:889-892.

RAZA, S.H. 1978. Effect of some growth regulators on seed germination of Kalyanasona wheat. Ind. J. Agric. Res. 12(3):201-202.

SHIMADA, S., ATSUSHI, K. and SHOJI, A. 1981. The utilization of methoprene, a synthetic compound with JH activity on silkworm rearing. 3. Absorption, distribution with excretion of methoprene by the silkworm *Bombyx mori*. J. Sericult. (Japan) 50(5):391-395.

SINGH, G., SEKHON, N. and KAUR, M. 1978. Effect of growth regulators on some yield contributing parameters in *Arachis hypogaea*. J. Res. Punjab Agric. Univ. 15(1):106-111.

WAMPLE, R.L. and CULBER, E.B. 1983. The influence of paclobutrazol, a new growth regulator, on sunflower. J. Amer. Soc. Hort. Sci. 108(1):122-125.