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The Effect of Mineral Salts, Magnesium Sulphate and Potassium Nitrate on the Economic Parameters of Silkworm *Bombyx mori* L.

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The effect of topical application 100, 300 and 500 μg/ml with Mineral Salts of magnesium sulphate and potassium nitrate on economic parameters was analyzed following treatment of last larval stadium. The treated larvae showed significantly decreased larval weight and silk gland weight in all the treated groups along with other decreased larval, cocoon and adult parameters. The female cocoon weight was significantly decreased in all the treated groups with decreased female cocoon shell weight and male cocoon weight at 300 and 500 μg/ml respectively. The length and weight of filament was significantly decreased at 300 and 500 μg/ml respectively and denier at 500 μg/ml. The fecundity decreased significantly in 300 and 500 μg/ml treated groups when compared with the corresponding parameters of the carrier control.

Key words : Mineral Salts, Silkworm, Economic Parameters.

Introduction

In recent times, sericulture has undergone a sea change and has started wearing a new look (krishnaswami *et al.*, 1978). Fortification of mulberry leaves by supplementary nutrient and using them for feeding the silkworm is another useful technique to increase their economic value (Kumararaj *et al.*, 1972). It is well known that the cocoon crop of the silkworm, *B. mori*, depends on the developmental vigor of its breed, which in turn is further influenced by the quality of leaf fed to the worm (Venugopala *et al.*, 1987). The raw silk production per hectare of land is about 53 kg in China, 40 kg in Japan and just 14 kg in India (Bajpeyi *et al.*, 1991). The low productivity is mainly attributed to low mulberry yield and poor quality of leaf. Thus it appears that to boost up silk production some supplements are essential to the silkworm, along with its feed so search is being continued in this laboratory to explore the different exogenous agents, such as minerals, hormones and vitamins that can effectively augment the various life processes of silkworms and ultimately aggravate the production of silk and eggs.

The studies documented that different mineral salts supplementation to different races of silkworm, *B. mori* resulted in enhanced larval body weight, cocoon shell weight, cocooning and moth emergence percentage, metabolic activity, acid and alkaline phosphatase activity accompanied by reduction in larval duration and glycogen content of the silkgland (Chakraborthi and Medda, 1978; Bhattacharayya and Medda 1983; Magadum, 1987; Padaki, 1991; Islam and Khan, 1993; Nirwani and Kaliwal, 1995). However, the effects of mineral salts on economic parameters of the silkworm, *B. mori* are scanty. Therefore, the present study aims to reveal the effect of supplementation of a Mineral Salts containing magnesium sulphate and potassium nitrate on the economic parameters of the silkworm, *B. mori* L.

Materials and Methods

The disease free layings (DFLS) of multivoltine race (PM $\times$ NB_{18}) of the silkworm were obtained from Grainage Center, Rayapur, Dharwad, Karnatak and reared in the laboratory by improved methods of silkworm rearing (Krishnaswami, 1978). The V stadium larvae divided into five experimental groups including controls and every group consists of uniformaly weighed larvae in five replications of 20 worms. The magnesium sulphate procured form E-Merch, A.G. Darmstat, Germany and potassium

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nitrate procured from BDH, India. These Mineral Salts are mixed in equal composition and dissolved in distilled water to give three concentrations viz., 100, 300 and 500 μg/ml. The Mineral Salts was uniformly sprayed on fresh mulberry leaves with each concentration and the leaves were dried and fed to the fifth stadium silkworm alternatively with untreated and treated mulberry leaves. Two feedings were with treated leaves and the remaining two feedings were with untreated leaves per day. The carrier controls were fed with distilled water sprayed leaves and normal controls with untreated leaves.

The larval, cocoon and adult parameters were recorded separately. The larval and silk gland weights were measured before commencement of the spinning. The larval duration was measured from the day of hatching to till the completion of spinning. The cocoon parameters such as female and male cocoon weights and their shell weights were measured on the 5th day after the completion of spinning activity and filament length was recorded with epprovette by reeling single cocoon. The reeled silk was dried in hot air oven and weight was taken in the electrical balance. The cocoon shell ratio and denier of the filament was calculated. The adult parameters such as moth emergence percentage, length of the ovariole, eggs per ovariole, fecundity and hatching percentage were recorded after the moth emergence. The cocooning percentage, moth emergence percentage and hatching percentage were calculated by the formula shown in the tables. Each mean value a record of ten observations is shown in Table 1, 2 and 3.

The data collected were subjected to analysis of variable to find out the significance between the parameters of the untreated and treated groups (Raghava Rao, 1983). The percent values of cocooning, female and male cocoon shell ratio and hatching percentage were transformed to sign angular values for statistical analysis. The percent index was calculated for each parameter of the experimental groups over those of the corresponding parameters of the carrier control.

Results and Discussion

The data on the effect of Mineral Salts of magnesium sul-

Table 1. Effect of minerals mixture of magnesium sulphate and potassium nitrate on the larval parameters of the silkworm, B. *mori*

Treatment	Dose μg/ml	Larval weight (g)	Silk gland weight (g)	Larval duration (hr)	Cocooning percentage (%)
Magnesium sulphate + Potassium nitrate	100	2.442*	1.072*	639.2	94.8 76.82**
		(92)	(94)	(98)	(99)
Magnesium sulphate + Potassium nitrate	300	2.456*	1.066*	650.6	95.2 77.34**
		(92)	(94)	(100)	(99)
Magnesium sulphate + Potassium nitrate	500	2.356*	0.986*	655.6	95.4 77.61**
		(88)	(86)	(100)	(100)
Carrier control	Distilled water	2.652	1.134	649.8	95.4 77.61**
		(100)	(100)	(100)	(100)
Normal control	-	2.596	1.106	660.8	95.0 77.08**
		(97)	(97)	(101)	(100)
		S	S	NS	NS
S.Em±		0.096	0.024	13.528	0.604
CD at 5%		0.188	0.047	28.679	1.282

* - Significant increase/decrease at 5%
** - Angular transformed values
S - Significant
NS - Non significant
S.Em± - Standard error mean
CD - Criticle difference
Percentage increase/decrease over that of the carrier control in parenthesis.

Table 2. Effect of minerals mixture of magnesium sulphate and potassium nitrate on the cocoon parameters of the silkworm, *B. mori*

Treatment	Dose µg/ml	Female cocoon weight (g)	Female cocoon shell weight (g)	Female cocoon shell ratio (%)	Male cocoon weight (g)	Male cocoon shell weight (g)	Male cocoon shell ratio (%)	Filament length (mts)	Filament weight (g)	Denier
Magnesium sulphate + potassium nitrate	100	1.235*	0.197	15.95 23.50**	1.198	0.194	16.21 23.73**	580.0	0.155	2.408
		(81)	(91)	(112)	(92)	(96)	(104)	(96)	(96)	(99)
Magnesium sulphate + potassium nitrate	300	1.284*	0.188*	14.64 22.46**	1.143*	0.186	16.23 23.73**	576.6*	0.152*	2.372
		(84)	(87)	(103)	(88)	(92)	(104)	(96)	(94)	(98)
Magnesium sulphate + potassium nitrate	500	1.227*	0.193*	15.72 23.34**	1.130*	0.182	16.10 23.73**	543.3*	0.139*	2.307*
		(80)	(89)	(110)	(87)	(90)	(103)	(90)	(86)	(95)
Carrier control	Distilled water	1.523	0.216	14.18 22.06**	1.290	0.201	15.58 23.34**	600.0	0.161	2.415
		(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)
Normal control	-	1.402	0.209	14.90 22.71**	1.224	0.186	15.19 22.95**	592.0	0.154	2.343
		(92)	(96)	(105)	(94)	(92)	(97)	(98)	(95)	(97)
		S	S	NS	S	NS	NS	S	S	S
S.Em±		0.062	0.012	0.942	0.054	0.010	0.841	9.275	0.005	0.037
C.D. at 5%		0.122	0.024	1.846	0.106	0.021	1.648	21.425	0.011	0.086

* - Significant increase/decrease at 5% ** - Angular transformed values S - Significant
NS - Non significant S.Em± - Standard error mean C.D. - Criticle difference
Percentage increase/decrease over that of the carrier control in parenthesis.

phate and potassium nitrate on the economic parameters of *B. mori* are presented in Table 1, 2. and 3.

Larval weight

The larval weight decreased significantly in all the Mineral Salts of magnesium sulphate and potassium nitrate treated groups when compared with that of carrier control (Table 1). However, the larval weight was significantly increased after supplementation of Mineral Salts of calcium, magnesium and natrum phosphates and zinc, iron, manganese, magnesium (Subburathianam and Sulochana Chetty, 1991, Vishanath and Krishnamurthy, 1982). The decrease in the larval weight might be due to the toxic effect of this Mineral Salts to midgut enzyme activity, since copper sulphate increases the midgut enzyme activity in *L. decemtineata* (Izhevskiy, 1976). Thus, the further investigation is essential to know the possible effect of Mineral Salts of magnesium sulphate and potassium nitrate on the larval weight.

Silkgland weight

The wet weight of the silk gland was significantly decreased in 300 and 500 µg/ml treated groups when compared with the corresponding parameters of the carrier control (Table 1). On the contrary, it has been reported that the wet weight of silk gland was significantly increased after supplementation with biosalt mixture of calcium, magnesium and natrum phosphates (Subburathianam and Sulochana Chetty, 1991). The decreased silk gland weight obtained in the present study might be due to toxic effect of these Mineral Salts at higher doses on the metabolic activity of the silk gland. Hence, further investigation is essential in this regard.

Larval duration and cocooning percentage

Supplementation with all the three concentration of mineral salts of magnesium sulphate and potassium nitrate had no effect on the larval duration and cocooning percentage thereby indicating that the used concentrations are

Table 3. Effect of minerals mixture of magnesium sulphate and potassium nitrate on the cocoon parameters of the silkworm, *B. mori*

Treatment	Dose µg/ml	Moth emergence percentage (%)	Fecundity (No.)	Hatching percentage (%)
Magnesium sulphate + potassium nitrate	100	88.0 69.73** (99)	680.0 (98)	87.0* 68.87** (96)
Magnesium sulphate + potassium nitrate	300	87.7 69.47** (99)	670.6* (97)	85.2* 67.37** (94)
Magnesium sulphate + potassium nitrate	500	87.0 68.87** (98)	657.6* (95)	84.8* 67.05** (94)
Carrier control	Distilled water	88.5 70.18** (100)	687.0 (100)	90.0 71.56** (100)
Normal control	-	88.5 70.18** (100)	705.8 (95)	90.2 71.76** (100)
		NS	S	S
S.Em±		0.664	4.864	0.738
CD at 5%		1.448	10.312	1.566

* - Significant increase/decrease at 5%
** - Angular transformed values
S - Significant
NS - Non significant
S.Em± - Standard error mean
CD - Criticle difference
Percentage increase/decrease over that of the carrier control in parenthesis.

allowance limits and have not adversely affected the larval duration and cocooning percentage (Table 1).

Cocoon weights and its shell weights

The female cocoon weights were significantly decreased in all the treated groups and its shell weights were significantly decreased in 300 and 500 µg/ml treated groups. In male, the cocoon weighs were significantly decreased in 300 and 500 µg/ml and shell weights were decreased but not significant in all the treated groups when compared with the corresponding parameter of the carrier control (Table 2). The results of the present study suggest that the used higher concentration, 300 and 500 µg/ml, has the toxic effects on cocoon weights and its shell weights. Decrease in the female and male shell weights are preceded by the decreased in silk gland weight at higher doses. The significant increase/decrease in cocoon shell ratio is given in Table 2.

Filament length, weight and denier

A significant decrease in the filament length and filament weights were obtained in 300 and 500 µg/ml and denier in 500 mg/ml treated groups when compared with the corresponding parameters of the carrier control (Table 2).

Moth emergence percentage

The results of the present study showed significantly decreased in the moth emergence percentage at 500 µg/ml treated group when compared with carrier control (Table 3). This indicates that at these concentration of mineral salts of magnesium sulphate and potassium nitrate has the lethal effect on the pupae and cocoon crop.

Fecundity

The present study suggests that the fecundity was significantly decreased at 300 and 500 µg/ml treated groups when compared the carrier control (Table 3). The significant decrease in the fecundity is preceded by decrease in the eggs per ovariole.

Hatching percentage

These results suggest that the hatching percentage was

significantly decreased in all the treated groups when compared with the carrier control (Table 3). This indicates that at these doses there is toxic effect on the silkworm embryo.

Insects, like vertebrate require a variety of minerals, for certainly mineral elements cannot biosynthesised. So complex salt mixtures are essential components always included in insect diets (House, 1967). The silkworm, *B. mori*, being monophagous insects, derives almost all the nutrients and minerals required for its growth from the mulberry leaf itself. Minerals are essential elements and their effect varies metabolic processes (House, 1965). In silkworms only few elements are essential and insight is based on species. The mineral salts can play a vital role in the physiological processes in lepidopteran silkworm races wherein they stimulate the body growth, shorten the larval period and increase the shell weights significantly (Vishanath and Krishnamurthy, 1982; Subburathianam and Sulochana Chetty, 1991).

In conclusion, the results of the present study show that the mineral salts of magnesium sulphate and potassium nitrate decrease the silk yield like larval weight, silk gland weight, cocoon weight and its shell weight, filament length, weight and denier and reproductive performance like eggs per ovariole, fecundity and hatching percentage. Since, the mineral salts of magnesium sulphate and potassium nitrate have toxic effect on silk yield and reproductive performances. Thus, additional studies using other races of silkworm and variety of exercise paradigms will be necessary to determine the physiological significance and generalizability of present results.

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