

## GROWTH REGULATORS : APPLICATION IN SERICULTURE

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**S**ERICULTURE is an agro-based rural oriented industry, where money flows from rich to poor. It provides gainful occupation through out the year not only to skilled and semi-skilled laborers, but also to un-skilled, uneducated rural mass. It can also be practiced as a house hold activity, where all members of the family contribute to the success. Hence, it is rightly said that sericulture is a boon to rural farmers. Its contribution to employment generation is undisputed. Its returns are assured, regular and substantial.

Though, India is the second largest silk producer in the world, there is a great difference with regard to the quantity and quality of the silk produced by India and the world leader China. It is also true that India is the largest silk importer of the world. Hence, one can understand the heavy demand for this gorgeous material. To fill-up the gap, Indian sericulturists have tried several methods for improving the quality and quantity of silk production. Utilization of growth regulator is one of them.

Modern research on growth substance began about 70 years ago. In 1926, Went in the Netherlands presented irrevocable evidence of a diffusible substance obtained from oat seedlings which promoted growth of the seedlings, heralded the beginning of auxin era<sup>1</sup>. Later, many workers used several other growth regulators of both synthetic and natural origin like plant products to desired characters in many plants.<sup>2-6</sup>

Chemical growth regulators like auxins, gibberellins Juvenile hormones (JH) etc., are being widely used in plants to improve desired quantity and quality of plant product.<sup>2-4,7</sup>

In animals, the growth regulators were first used as drug to control pests. However, Kobayashi for the first time utilized the moulting hormone to increase the cocoon yield in silkworm.<sup>8</sup> Later, many workers studied the effect of several other growth hormones such as Juvenile hormone (JH), moulting hormone (MH), anti-juvenile hormone (anti-JH) and their analogues on cocoon yield, silk production, larval duration, metamorphosis etc.

Among several growth regulators used in the field, Paraaminobenzoic acid (PABA) is known to have a role in microbial nutrition and considered as a bacterial vitamin, whereas Indole Acetic Acid (IAA), a heteroauxin, is a natural plant growth hormone, which acts to promote growth by

promoting elongation of cells, while several other commercial formulations are also known to have mainly vitamin B, B12, auxins and other pH regulators.

Growth regulators are formulations, which used either to promote or to restrict vegetative growth. They may also improve the productivity of specific plant part. Hence, the growth promoters are mainly used to improve the vegetative growth, thus increase biomass and productivity. Another group of growth regulators, which contain micronutrients such as iron, boron, magnesium, zinc, molybdenum, copper etc., in a very small quantities, are known as micronutrient based growth regulators and these will supplement the required micronutrient, which are deficient in any given soil. Further, it is well documented that, depletion of soil nutrients or imbalance of nutrients is caused as a result of many chemicals reactions taking place in soil, will also be supplemented by treating these soils with such a growth regulators.

As the quantity of silk produced depend on the quantity and quality of mulberry leaves, scientists have tried to use growth regulators to improve yield in mulberry (*Morus alba*), the sole food plant of silkworm *Bombyx mori*. There are reports of extensively using of not only naturally occurring growth regulators, but also of a humpteen number of commercial formulations such as Navras, Vipul, Superspin, Triacontanol<sup>9-13</sup>, which are known to have auxins, gibberellins and cytokinines such as IAA, IBA, GA, PABA are also known to have in sufficient quantities of vitamins such as B, B12 etc., record for healthy growth in different combinations and concentrations. These growth regulators of both natural and commercial nature are found to be suitable for increasing productivity not only under natural, but also under stress conditions.

As mentioned earlier, a number of micro-nutrient based products are available in market. They show a visible improvement either on account of micronutrient composition or due to the presence of essential micronutrients such as iron, manganese, copper, zinc, molybdenum, boron etc., in their formulations.

As a step forward, scientists have tried to administer these chemical growth regulators directly to silkworm *B. mori* by following administration methods such as oral feeding, topical application, sub-cutaneous injection at various developmental stages and obtained desired results.<sup>13-18</sup>

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Using normal mulberry leaves as feed, Akai and Kobayashi<sup>19</sup> reported that JH administration prolongs larval duration. Nihmura *et al.*,<sup>20</sup> utilised synthetic compound with JH to obtain higher shell ratio and shell weight in silkworms. Akai *et al.*,<sup>21</sup> showed the influence of JH on growth and metamorphosis in silkworms. Later Muroga *et al.*,<sup>22</sup> and Akai,<sup>23</sup> showed the effect of juvenoids on silk production. There are also reports of utilisation of JH in silkworm rearing where artificial diet is used to rear the worms.<sup>23-25</sup>

Kobari and Akai<sup>26,27</sup> used 'manta' (Synthetic compound with JH activity) to study its effect on cocoon characters and obtained cocoons of better economic value. Manta and Methoprene also improved cocoon characters.<sup>28-35</sup>

Krishnasami *et al.*,<sup>17,36</sup> studied the effect of chloramphenicol (a by-product of PABA metabolism) and JH analog ZR 512 on growth and economic characters of silkworm and concluded that growth regulators improve economic traits. Akai *et al.*,<sup>37</sup> using 1-citronellyl-5-phenylamidoazole as anti-JH, Shoji *et al.*,<sup>38,39</sup> and Kuwano *et al.*,<sup>40</sup> observed increased larval body weight. Similarly Kanika *et al.*,<sup>41</sup> studied the effect of anti-JH Labonin on silkworms and concluded that it improves the cocoon weight and shell weight.

Indian scientists have also experimented and reported improvement of silk by using growth regulators including PABA, Juvenile hormones (JH), antibiotics like chloromycetin, phenylalanine and several other commercial formulations.<sup>8,36,42-44</sup>

Advantages of using growth regulators are such that (1) It increases the growth and biomass production, (2) It expedites the developmental rate, (3) It recovers deficiency symptoms very fast (Compared to soil application), (4) Minimum quantity of nutrient can be effectively used to minimize the cost, (5) Different formulations can be used in compatible combinations, (6) It helps to develop resistance against pests, diseases etc., (7) It appears very effective during post monsoon season, (8) Growth regulators make available the growth stimulants to the plants when they are in need, (9) Regulators make nutrients more readily available to the plants by increasing the uptake, resulting in increased growth rate, greater health and vigour of plant and ultimately higher yield, (10) Relatively economical and results in significant improvement of yield.

Disadvantages are being (1) Only a limited quantity of nutrients can be supplemented, (2) toxicity, mutagenicity of the nutrient should be carefully monitored before using, (3) Growth regulators may help the unwanted herbs, weeds to grow faster, (4) Application of growth regulators may lead to adverse effects on fast growing plant species, particularly under soil nutrient stress conditions, (5) Seasonal interactions of the spray solution particularly under hot climatic conditions of the tropical area could be detrimental, (6) For development of chlorophyll pigments notices with some of the foliar spray could be misleading since the change need not always

improve leaf quality in mulberry, (7) Many a times, though growth promoters improve quantitative characters, qualitative traits are adversely affected, (8) Growth promoters generally reduce fitness characters in silkworms, (9) Post cocoon characters are adversely affected, (10) No reports are there on the action of growth regulators in subsequent generation of the treated silkworms, (11) Not effective during rainy seasons because the administered growth promoter may be washed off by the rains.

Thus, as we know adaptability, affordability and accountability are the key factors that decide the fate of a technology, an intelligent and judicious use of growth regulators could be successfully adapted and they hold promise for sericulture in future. □

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