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# Comparison of Response to Selection in Three Commercial Pure Lines of Silkworm in Spring and Autumn Seasons

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**Abstract:** An experiment was done in order to comparison of response to selection in three commercial pure lines of silkworm in spring and autumn seasons. Base population in each line consists of two selective and randomly groups. Selective group to each of the studied lines, superior 40 cocoon male and 40 cocoon female based on single cocoon weight after single recording of the three cocoon weight traits, cocoon shell weight and cocoon shell percentage of the population was selected 3P and another random mating were given. Random group (control) related to each of the studied lines, 40 male cocoon and 40 female cocoons randomly selected without any recording of the mentioned traits among 3P population had been gathered and crossed. In the first generation of the 40 produced larvae eggs categories in each group of each line, 8 categories with hatched percentage and suitable fertility for breeding were hatched. Thus each group consisted of 8 families in each line of brothers and sisters (with a parent). All the first generation, data files consist of 2400 records for each of three traits (800 records per line). Finally among the 8 families per group in each line 40 male cocoons and 40 female cocoons were crossed randomly to produce 40 larvae eggs categories of next generation. Breeding process and producing row data in second generation or 2p and third generation or p was done as the same as the first generation. All data files in all lines contain 7680 records from each of the three traits were studied (2560 records in each line). It should be noted that only selected population in all lines was done just in vase population and all crossing in nest generations were carried out randomly. According to information available to separate spring and fall seasons, the effects of data were separated and the response to selection separately for each season, were recorded and saved in the computer. Separation of effects in spring and fall seasons and compare responses to a choice of three lines of the above actions seaso effect showed that spring effects on three traits of 27 trait and autumn effect on four traits of these traits was significant statistically. Individual selection performance comparisons in base population of above three commercial lines based on cocoon weight and response to selected three lines for 27 traits examined in this study showed that spring effect on three traits of 27 studied traits is significant and the autumn on the four traits have significant effects. Spring effect on three traits in the pupae vitality percentage in middle cocoons, larvae duration and the un-hatched eggs number, the autumn on four traits was significant effects. Spring effect on three traits of pupae vitality percentage in middle cocoon, larvae duration and un-hatched eggs number was significant. Autumn effect on three traits of pupae vitality percentage in best cocoon, best cocoon percentage, middle cocoon percentage and un-hatched eggs number was significant.

**Key words:** *Bombyx mori*, season, parent, selection, performance, spring

## INTRODUCTION

Silk, a substance that is produced from silkworm saliva which is applied in silk textile industry, rubber making, military, pharmaceutical, soup making and carpet making. Of course in medicine, artificial blood vessels and the surgical thread prepare of silk is used which have good quality and outcome. It should be noted that unlike peoples' idea, silkworm is not only important in production but also its stool is used in preparing organic fertilizer, E and K vitamins and also to feed livestock and aquaculture (Ahsan and Rahman, 2002; Seidavi and Bizhannia, 2008). The objective of animal breeding is not improving an animal but improvement of animal communities to improve future generations (Phashmi *et al*., 2007) and the ultimate goal of breeding activities is access to genetic improvement not improving environmental conditions (Seidavi and Bizhannia, 2008). Breeding specialist can rank cattle breeding based on their breeding values and remove low ranking animals and

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choose high ranking for replacement in the herd (Shodja and Pirani, 2005). Selection is a way for long-term genetic changes in animals (Phashmi *et al*., 2007).

Breeding with selection of genetically superior animals with the help of suitable mating techniques, make superior livestock and poultry and in this case after selecting the best animals use them to produce the next generation. The purpose of selection is that allow people with the best gene set to reproduce to have more desirable genes over present generation.

Selection is the first tool to make genetic change by reformers (Phashmi *et al*., 2007). But what is important is that in practical terms usually mean an increase of >1 trait in the breeding program is considered. It may be some traits, independent of each other and positive or negative correlation. The importance of different traits may not be the same. Thus, knowledge of inheritability and correlation between economic characteristics is important. Genetic change in one or more selected traits of the other traits called correlated response to selection is called (Phashmi *et al*., 2007).

Mean change results in compared with the average parent called response to selection (Shodja and Pirani, 2005). Breeding with selected comparisons to response to various lines together to select the genetically superior animals with the help of suitable mating techniques make superior livestock and poultry and in this case after selecting the best animals use them to produce the next generation. Since, there is not a report about responses to the selection of economic characteristics of commercial lines of silkworm in different seasons, this research is carried out and considered the first study.

## MATERIALS AND METHODS

To implement this research project according to records available before estimates about three commercial lines 32, 104 and 110 Iran silkworms and from Iran silkworm research center for each of these three lines, a selected group consisting average higher cocoon weight of population and a control group composed of populations with similar average population as base population were studied. Base population was formed and in each line composed of two selective and randomly lines. Selected group to each of the studied lines on top 40 male cocoon and 40 female cocoon weight based on single cocoon weight after recording from the three cocoon traits, cocoon weight, cocoon shell weight and cocoon shell percentage of the population was selected and 3P another random mating were given. Random group (control) to each of the studied lines 40 male cocoon and 40 female cocoon randomly selected without any solo recording of the traits mentioned among 3P population had been gathered and crossed. Thus in each selected group, randomly and each of 40 product lines of production licenses had been included in total base population of 480 records each of the three traits were studied (160 records per line).

Generations after the breeding and egg production in control groups and selective Larvae in separate directions were followed. In the first generation of the 40 produced larvae eggs categories in each group of each line, 8 categories with hatched percentage and suitable fertility for breeding were hatched. Thus each group consisted of 8 families in each line of brothers and sisters (with a parent).

All the first generation, data files consist of 2400 records for each of three traits (800 records per line). Finally among the eight families per group in each line 40 male cocoons and 40 female cocoons were crossed randomly to produce 40 larvae eggs categories of next generation.

Breeding process and producing row data in second generation or 2p and third generation or p was done as the same as the first generation. All data files in all lines contain 7680 records from each of the three traits were studied (2560 records in each line.) It should be noted that only selected population in all lines was done just in vase population and all crossing in nest generations were carried out randomly. According to information available to separate spring and fall seasons, the effects of data were separated and the response to selection separately for each season were recorded, saved, analyzed and compared.

## RESULTS

The results of this research after selection action in base population based on cocoon weight for each three lines (32, 104 and 110) in spring and autumn seasons have shown separately in Table 1 and 2. Among 27 studied traits in this research, 7 low cocoon number, low cocoon percentage, larvae duration, un-hatched eggs number, un-hatched eggs percentage, un-fertilized eggs percentage are a part of negative traits in sericulture industry and increase in their range means unimprovement in their range.

- The comparison of performance of single selection system in base population and response to selection for studied traits by spring effect

Table 1: The comparison of performance of single selection system in base population and response to selection for studied traits at spring season*

| Factors | 32 | 104 | 110 |
|---|---|---|---|
| Alive larvae number | 48.2500 | 19.6300 | 68.1400 |
| Alive pupae number | 27.6300 | 17.5000 | 57.2900 |
| Pupae vitality percentage | -5.2000 | -0.5240 | -2.5590 |
| Pupae vitality percentage (best cocoon) | -5.2060$^{b}$ | 0.3130$^{a}$ | -2.4960$^{ab}$ |
| Pupae vitality percentage (middle cocoon) | -4.4900 | 2.3180 | -0.9990 |
| Produced cocoon number | 49.8800 | 18.8800 | 67.2900 |
| Best cocoon number | 30.2500 | 17.7500 | 28.5700 |
| Middle cocoon number | 19.7500 | 0.5000 | 31.2900 |
| Low cocoon number | 1.1250 | -0.7500 | 2.7140 |
| Double cocoon number | -1.2500 | 1.3750 | 4.7140 |
| Best cocoon percentage | 30.3500$^{a}$ | -2.9800$^{a}$ | -10.2200$^{b}$ |
| Middle cocoon percentage | 22.2380$^{a}$ | 3.6550$^{b}$ | 7.8990$^{b}$ |
| Low cocoon percentage | -0.7575 | -0.8463 | 0.7757 |
| Double cocoon percentage | -0.7650 | 0.1740 | 1.5530 |
| Best cocoon weight | 51.1700 | 43.0400 | 87.8800 |
| Double cocoon weight | 0.1259 | 0.2538 | -0.0477 |
| Single best cocoon weight | -2.6120 | 0.0230 | 1.7440 |
| 10000 larvae cocoon weight | -130.1000 | 380.4000 | -257.2000 |
| Larval duration | 0.0000$^{a}$ | 0.0000$^{a}$ | -12.0000$^{b}$ |
| Hatched larvae | 43.6300 | -23.7500 | 56.7100 |
| Un-hatched eggs | -0.2500 | -8.5000 | -3.4290 |
| Unfertilized eggs | -3.7500 | -3.1250 | -8.0000 |
| Hatched eggs percentage | 1.0400 | 1.7190 | 2.9900 |
| Un-hatched eggs percentage | -0.1410 | -1.2840 | -0.9000 |
| Unfertilized eggs percentage | -0.8990 | -0.4360 | -2.0910 |
| Hatchability percentage | 0.1510 | 1.3180 | 0.9760 |
| Total produced eggs | 39.6300 | -35.3800 | 45.2900 |

*There is significant difference between the numbers that are shown with the different letter (s) in each row ($p<0.05$). Each row of data without any letter has not significant differences ($p>0.05$)

Table 2: The comparison of performance of single selection system in base population and response to selection for studied traits at autumn season*

| Factors | 32 | 104 | 110 |
|---|---|---|---|
| Alive larvae number | 68.1400 | 19.6300 | 48.2500 |
| Alive pupae number | 57.2900 | 17.5000 | 27.6300 |
| Pupae vitality percentage | -2.5590 | -0.5240 | -5.2000 |
| Pupae vitality percentage (best cocoon) | -2.4960$^{ab}$ | 0.3130$^{a}$ | -5.2060$^{b}$ |
| Pupae vitality percentage (middle cocoon) | -0.9990 | 2.3180 | -4.4900 |
| Produced cocoon number | 67.2900 | 18.8800 | 49.8800 |
| Best cocoon number | 28.5700 | 17.7500 | 30.2500 |
| Middle cocoon number | 31.2900 | 0.5000 | 19.7500 |
| Low cocoon number | 2.7140 | -0.7500 | 1.1250 |
| Double cocoon number | 4.7140 | 1.3750 | -1.2500 |
| Best cocoon percentage | -10.2200$^{b}$ | -2.9800$^{a}$ | 30.3500$^{a}$ |
| Middle cocoon percentage | 7.8990$^{b}$ | 3.6550$^{b}$ | 22.2380$^{a}$ |
| Low cocoon percentage | 0.7757 | -0.8463 | -0.7575 |
| Double cocoon percentage | 1.5530 | 0.1740 | -0.7650 |
| Best cocoon weight | 87.8800 | 43.0400 | 51.1700 |
| Double cocoon weight | -0.0477 | 0.2538 | 0.1259 |
| Single best cocoon weight | 1.7440 | 0.0230 | -2.6120 |
| 10000 larvae cocoon weight | -257.2000 | 380.4000 | -130.1000 |
| Larval duration | -12.0000$^{b}$ | 0.0000$^{a}$ | 0.0000$^{a}$ |
| Hatched larvae | 56.7100 | -23.7500 | 43.6300 |
| Un-hatched eggs | -3.4290 | -8.5000 | -0.2500 |
| Unfertilized eggs | -8.0000 | -3.1250 | -3.7500 |
| Hatched eggs percentage | 2.9900 | 1.7190 | 1.0400 |
| Un-hatched eggs percentage | -0.9000 | -1.2840 | -0.1410 |
| Unfertilized eggs percentage | -2.0910 | -0.4360 | -0.8990 |
| Hatchability percentage | 0.9760 | 1.3180 | 0.1510 |
| Total produced eggs | 45.2900 | -35.3800 | 39.6300 |

*There is significant difference between the numbers that are shown with the different letter(s) in each row ($p<0.05$). Each row of data without any letter has not significant differences ($p>0.05$)

**The comparison of performance of single selection system in base population and response to selection for trait of alive larvae number in spring:** The results of this examination showed that selection in base population based on weight number in spring cause increasing alive larvae number in each three lines 32, 104, 110 in line 32 in amount of 22.880 larvae and in line 104 in amount of 24.810 larvae and in line 110 in amount of 27.560 larvae. But the comparison to response to selection of these three lines is not significant statistically ($p>0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of alive pupae number in spring:** The results of this examination showed that selection in base population based on cocoon weight in spring cause increasing alive pupae number in each three lines 32, 104, 110 in line 32 in amount of 16.19 pupae and in line 104 in amount of 26.75 pupae and in line 110 in amount of 24.88 pupae. But the comparison to response to selection of these three lines is not significant statistically ($p>0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of pupae vitality percentage in spring:** The results of this examination showed that selection in base population based on cocoon weight in spring observed increasing pupae vitality just in line 104 but decreased in line 32 and 110. In line 104 in amounts of 1.498 but in line 32 and 110-0.966 and -1.410, respectively. But the comparison of response in theses three lines showed that the difference among response to these three lines is not significant statistically ($p>0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of pupae vitality percentage (best cocoon) in spring:** The selection in base population based on pupae vitality percentage (best cocoon) during three generation in spring in line 32 and 110 caused increasing this trait in amount of 0.850 and 0.793%, respectively but decreased in line 104 in amount of -0.466% after selection action and comparison of response in three line is not significant statistically ($p>0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of pupae vitality percentage (middle cocoon) in spring:** The selection in base population based on cocoon weight during three generation in spring in line 32 caused decreasing this trait in amount of -7.005% but increased in line 104 and 104 in amount of 11.699 and 0.470%, respectively. After selection action and comparison of response in three line is significant statistically ($p<0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of produced cocoon number in spring:** Obtained results from this research showed that during three generations in spring, the selection in base population based on cocoon weight caused increasing produced cocoon number in each three lines 32,104 and 110. Increasing this trait in line 32 equals 28.88 cocoon in line 104 equals 25.00 and in line 110 equals 29.06 cocoon. With comparison carried out between responses to the selection of these three lines, no significant difference was observed ($p>0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of best cocoon number in spring:** Based on selection in base population based on cocoon weight during three generation in spring in three lines 32, 104, 110 increased with amount of 29.06, 7.94 and 22.38, respectively. With comparison carried out between responses to the selection of these three lines, no significant difference was observed ($p>0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of middle cocoon number in spring:** By the selection carried out based on base population, there was increased middle cocoon number in spring for these three lines. Total during three selection generations increasing rate for line 32 equals 3.75 for line 104, 16.50 and for line 110 equals 5.00. With comparison carried out between responses to the selection of these three lines, no significant difference was observed ($p>0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of low cocoon number in spring:** By the selection carried out based on base population, there was increased middle cocoon number in spring (un-improvement) for these three lines. Total during three selection generations increasing rate for line 32 equals 0.438 for line 104, 0.125 and for line 110 equals 2.813. With comparison carried out between responses to the selection of these three lines, no significant difference was observed ($p>0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of double cocoon number in spring:** Based on cocoon weight, selection in base population caused decreasing trait of double cocoon number in spring, totally during three generations in line 32 and 110 in amount of -4.375 and -1.125, respectively but increasing in line 104 in amount of 0.438. With comparison carried out between responses to the selection of these three lines, no significant difference was observed ($p>0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of best cocoon percentage in spring:** By the selection carried out based on base population during three generation, the trait of best cocoon percentage in spring increased in line 32 and 110 in amount of 0.098 and 2.321%, respectively but decreased this trait in line 104 in amount of -3.206%. With different response to the trait of these three lines, significant difference was observed ($p<0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of middle cocoon percentage in spring:** During three generations selection, obtained results showed that in each three lines 32 and 110, observed increasing trait of middle cocoon percentage in spring. This showed that in line 32 was in amount of 0.006% in line 110 in amount of 3.570% and but decreased in line 104 in amount of -2.109%. With different response to the trait of these three lines, no significant difference was observed ($p>0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of low cocoon percentage in spring:** The selection in base population based on cocoon weight during three generation in spring in line 32 and 104 caused decreasing this trait in amount of -0.130 and -0.050%, respectively (improvement by selection) but increased in line 110 in amount of 0.929% (un-improvement by selection). With comparison carried out between responses to the selection of these three lines, no significant difference was observed ($p>0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of Double cocoon percentage in spring:** During three generations selection, obtained results showed that in each three lines 32, 104 and 110, observed decrease trait of double cocoon percentage in spring.

This showed that in line 32 was decreased in amount of -1.974% in line 104 in amount of -0.310% and in line 110 in amount of -0.141%. With different response to the trait of these three lines, no significant difference was observed ($p>0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of best cocoon weight in spring:** During three generations selection, obtained results showed that in each three lines 32 and 110, observed increase trait of best cocoon weight in spring. This showed that in line 32 was increased in amount of 71.57g in line 110 in amount of 0.009 g but decreased in line 104 in amount of -0.003 g. With different response to the trait of these three lines, no significant difference was observed ($p>0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of double cocoon weight in spring:** The selection in base population based on cocoon weight in spring during three generation in line 32 and 104 caused increased this trait in amount of 0.06 g and 0.28 g, respectively but decreased in line 110 in amount of -18.89 g. With comparison carried out between responses to the selection of these three lines, no significant difference was observed ($p>0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of single best cocoon weight in spring:** By the selection carried out based on base population during three generation, the trait of single best cocoon weight decreased only in line 104 in amount of -0.003 g but increased this trait in line 32 in amount of 0.100 g and in line 110 in amount of 0.009 g. With different response to the trait of these three lines, no significant difference was observed ($p>0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of 10000 larvae cocoon weight in spring:** By the selection carried out based on base population during three generation, the trait of 10000 larvae cocoon weight in spring increased in line 32 in amount of 684.0 g but decreased this trait in line 104 in amount of -420.9 g and in line 110 in amount of -296.6 g. With different response to the trait of these three lines, no significant difference was observed ($p>0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of larvae duration in spring:** The selection in base population based on larvae duration during three generation in line 32 and 104 caused increasing this trait in amount of 0.750 and 4.625 h, respectively (un-improvement by selection) but decreased in line 110 in amount of 0.500 h (improvement by selection). With comparison carried out between responses to the selection of these three lines, significant difference was observed ($p<0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of hatched larvae number in spring:** During three generations selection, obtained results showed that in each three lines 32, 104 and 110, observed increase trait of hatched larvae number in spring. This showed that in line 32 was decreased in amount of 80.25% in line 104 in amount of 7.06% and in line 110 in amount of 82.69%. With different response to the trait of these three lines, no significant difference was observed ($p>0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of un-hatched eggs number in spring:** The selection in base population based on un-hatched eggs number in spring during three generation in line 32 caused increasing this trait in amount of 10.625 eggs (un-improvement by selection) but decreased in line 104 and 110 in amount of -2.250 and -7.313 eggs, respectively (improvement by selection). With comparison carried out between responses to the selection of these three lines, significant difference was observed ($p<0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of un-fertilized eggs number in spring:** The selection in base population based on un-fertilized eggs number in spring during three generation in line 32, 104 and 110 caused decreasing eggs (improvement by selection). According to obtained results after selection action, the un-fertilized eggs number decreased in line 32, 104 and 110 in amount of -12.125, -0.438 and -3.563 eggs, respectively. With comparison carried out between responses to the selection of these three lines, no significant difference was observed ($p>0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of hatched eggs percentage in spring:** The selection in base population based on hatched eggs percentage in spring during three generation in line 32, 104 and 110 caused increasing this trait in amount of 1.045, 0.209 and 2.474%, respectively. With comparison carried out between responses to the selection of these three lines, no significant difference was observed ($p>0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of un-hatched eggs percentage in spring:** The selection in base population based on un-hatched eggs

percentage in spring during three generation in line 32 caused increasing this trait in amount of 1.210% (un-improvement by selection) and decrease in line 104 and 110 in amount of -0766 and -1.483%, respectively. It is noticed that decreasing this trait means improvement by selection is negative trait. With comparison carried out between responses to the selection of these three lines, no significant difference was observed (p>0.05).

**The comparison of performance of single selection system in base population and response to selection for trait of un-fertilized eggs percentage in spring:** The selection in base population based on un-fertilized eggs percentage in spring during three generation in line 32 and 110 caused decreasing eggs in amount of -2.257 and -0.991%, respectively (improvement by selection) and increasing in line 104 in amount of 0.556% (un-improvement by selection). With comparison carried out between responses to the selection of these three lines, no significant difference was observed (p>0.05).

**The comparison of performance of single selection system in base population and response to selection for trait of hatchability percentage in spring:** The selection in base population based on hatchability percentage in spring during three generation in line 104 and 110 caused increasing this trait in amount of 0.751 and 1.571%, respectively but decreased in line 32 in amount of -1.149%. With comparison carried out between responses to the selection of these three lines, no significant difference was observed (p>0.05).

**The comparison of performance of single selection system in base population and response to selection for trait of total produced eggs number in spring:** The selection in base population based on total produced eggs number in spring during three generation in line 32, 104 and 110 caused increasing this trait in amount of 78.75, 4.38 and 71.81%, respectively. With comparison carried out between responses to the selection of these three lines, no significant difference was observed (p>0.05).

- The comparison of performance of single selection system in base population and response to selection for studied traits by autumn effect

**The comparison of performance of single selection system in base population and response to selection for trait of alive larvae number in autumn:** The results of this examination showed that selection in base population based on cocoon weight in autumn cause increasing alive larvae number in each three lines 32, 104,110 in line 32 in amount of 48.25 larvae and in line 104 in amount of 19.63 larvae and in line 110 in amount of 68.14 larvae. But the comparison to response to selection of these three lines is not significant statistically (p>0.05).

**The comparison of performance of single selection system in base population and response to selection for trait of alive pupae number in autumn:** The results of this examination showed that selection in base population based on cocoon weight in autumn cause increasing alive larvae number in each three lines 32, 104,110 in line 32 in amount of 27.63 pupae and in line 104 in amount of 17.50 pupae and in line 110 in amount of 57.29 pupae. But the comparison to response to selection of these three lines is not significant statistically (p>0.05).

**The comparison of performance of single selection system in base population and response to selection for trait of pupae vitality percentage in autumn:** The results of this examination showed that selection in base population based on cocoon weight in autumn cause decreasing pupae vitality percentage in each three lines 32, 104, 110 in line 32 in amount of -5.200 pupae and in line 104 in amount of -0.524 pupae and in line 110 in amount of -2.559 pupae. But the comparison to response to selection of these three lines is not significant statistically (p>0.05).

**The comparison of performance of single selection system in base population and response to selection for trait of pupae vitality percentage (best cocoon) in autumn:** The selection in base population based on pupae vitality percentage (best cocoon) during three generation in autumn in line 32 and 110 caused decreasing this trait in amount of -5.206 and -2.496%, respectively but increased in line 104 in amount of -0.466% after selection action and comparison of response in three line is significant statistically (p<0.05).

**The comparison of performance of single selection system in base population and response to selection for trait of pupae vitality percentage (middle cocoon) in autumn:** The selection in base population based on pupae vitality percentage (middle cocoon) during three generation in autumn in line 104 caused increasing this trait in amount of 2.318% but decreased in line 32 and 110 in amount of -4.490 and -0.999%, respectively. After selection action and comparison of response in three line is not significant statistically (p>0.05).

**The comparison of performance of single selection system in base population and response to selection for trait of produced cocoon number in autumn:** Obtained results from this research showed that during three generations in autumn, the selection in base population based on cocoon weight caused increasing pupae vitality trait in middle cocoons in each three lines 32,104 and 110. Increasing this trait in line 32 equals 49.88 cocoon in line 104 equals 18.88 and in line 110 equals 67.29 cocoon. With comparison carried out between responses to the selection of these three lines, no significant difference was observed ($p>0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of best cocoon number in autumn:** Based on selection in base population based on cocoon weight during three generation in autumn in three lines 32, 104, 110 increased with amount of 30.25, 17.75 and 25.57, respectively. With comparison carried out between responses to the selection of these three lines, no significant difference was observed ($p>0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of middle cocoon number in autumn:** By the selection carried out based on base population, there was increased middle cocoon number in autumn for these three lines. Total during three selection generations increasing rate for line 32 equals 19.75 for line 104, 0.50 and for line 110 equals 31.29. With comparison carried out between responses to the selection of these three lines, no significant difference was observed ($p>0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of low cocoon number in autumn:** By the selection carried out based on base population, there was increased low cocoon number in autumn (un-improvement) for two lines of 32 and 110 in amount of 1.125 and 2.714 larvae, respectively. In line 104 decreased in amount of -0.750 (improvement by selection). With comparison carried out between responses to the selection of these three lines, no significant difference was observed ($p>0.05$). It should be noted that in a breeding program decreasing in traits mean improvement.

**The comparison of performance of single selection system in base population and response to selection for trait of double cocoon number in autumn:** Based on cocoon weight, selection in base population caused decreasing trait of double cocoon number in autumn, totally during three generations in line 32 in amount of -1.250 but increasing in line 104 and 110 in amount of 1.375 and 4.714, respectively. With comparison carried out between responses to the selection of these three lines, no significant difference was observed ($p>0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of best cocoon percentage in autumn:** By the selection carried out based on base population during three generation, the trait of best cocoon percentage in autumn increased in line 32 in amount of 30.35% but decreased this trait in line 104 and 110 in amount of -2.98 and -10.22%, respectively. With different response to the trait of these three lines, significant difference was observed ($p<0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of middle cocoon percentage in autumn:** During three generations selection, obtained results showed that in each three lines 32, 104 and 110, observed increasing trait of middle cocoon percentage in autumn. This showed that in line 32 was in amount of 22.238% in line 104 in amount of 3.655% and in line 110 in amount of 7.899%. With different response to the trait of these three lines, significant difference was observed ($p<0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of low cocoon percentage in autumn:** The selection in base population based on low cocoon percentage during three generation in autumn in line 32 and 104 caused decreasing this trait in amount of -0.757 and -0.846%, respectively but increased in line 110 in amount of 0.775%. With comparison carried out between responses to the selection of these three lines, no significant difference was observed ($p>0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of double cocoon percentage in autumn:** During three generations selection, obtained results showed that in line 32 observed decrease trait of double cocoon percentage in autumn. This showed that in line 32 was decreased in amount of -1.765% but in line 104 and 110 increased in amount of 0.174 and 1.553%, respectively. With different response to the trait of these three lines, no significant difference was observed ($p>0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of best cocoon weight in autumn:** During three generations selection, obtained results showed that in

each three lines 32, 104 and 110, observed increasing trait of best cocoon weight in autumn. This showed that in line 32 was in amount of 51.17 g in line 104 in amount of 43.04 g and in line 110 in amount of 87.88 g. With different response to the trait of these three lines, no significant difference was observed ($p>0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of double cocoon weight in autumn:** The selection in base population based on double cocoon weight in autumn during three generation in line 32 and 104 caused increased this trait in amount of 0.125 and 0.253 g, respectively but decreased in line 110 in amount of -0.047. With comparison carried out between responses to the selection of these three lines, no significant difference was observed ($p>0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of single best cocoon weight in autumn:** By the selection carried out based on base population during three generation, the trait of single best cocoon weight decreased only in line 32 in amount of -2.612 but increased this trait in line 104 in amount of 0.023 g and in line 110 in amount of 1.744 g. With different response to the trait of these three lines, no significant difference was observed ($p>0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of 10000 larvae cocoon weight in autumn:** By the selection carried out based on base population during three generation, the trait of 10000 larvae cocoon weight in autumn increased in line 104 in amount of 380.4 g but decreased this trait in line 32 in amount of -130.1 g and in line 110 in amount of -257.2. With different response to the trait of these three lines, no significant difference was observed ($p>0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of larvae duration in autumn:** The selection in base population based on larvae duration in autumn during three generation in line 32 and 104 caused no changes this trait but decreased in line 110 in amount of -12.00 h (improvement by selection). With comparison carried out between responses to the selection of these three lines, significant difference was observed ($p<0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of hatched larvae number in autumn:** During three generations selection, obtained results showed that in each three lines 32and 110, observed increase trait of double cocoon percentage in autumn. This showed that in line 32 and 110 was increased in amount of 43.63 and 56.71 larvae, respectively but decreased in line 104 in amount of -23.75 larvae. With different response to the trait of these three lines, no significant difference was observed ($p>0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of un-hatched eggs number in autumn:** During three generations selection, obtained results showed that in each three lines 32, 104 and 110, observed decreasing trait of un-hatched eggs number in autumn. This showed that in line 32 was in amount of -0.250 eggs in line 104 in amount of -8.500 eggs and in line 110 in amount of -3.429 eggs. With different response to the trait of these three lines, no significant difference was observed ($p>0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of un-fertilized eggs number in autumn:** The selection in base population based on un-fertilized eggs number in autumn during three generation in line 32, 104 and 110 caused decreasing eggs (improvement by selection). According to obtained results after selection action, the un-fertilized eggs number decreased in line 32, 104 and 110 in amount of -3.750, -3.125 and -8.000 eggs, respectively. With comparison carried out between responses to the selection of these three lines, no significant difference was observed ($p>0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of hatched eggs percentage in autumn:** The selection in base population based on hatched eggs percentage in autumn during three generation in line 32, 104 and 110 caused increasing this trait in amount of 1.040, 1.719 and 2.990%, respectively. With comparison carried out between responses to the selection of these three lines, no significant difference was observed ($p>0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of un-hatched eggs percentage in autumn:** The selection in base population based on hatched eggs percentage in autumn during three generation in line 32, 104 and 110 caused decreasing this trait in amount of

-0.141, -1.284 and -0.900%, respectively (improvement by selection). With comparison carried out between responses to the selection of these three lines, no significant difference was observed ($p>0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of un-fertilized eggs percentage in autumn:** The selection in base population based on un-fertilized eggs percentage in autumn during three generation in line 32, 104 and 110 caused decreasing eggs in amount of -0.899% and -0.436 and -2.091%, respectively. With comparison carried out between responses to the selection of these three lines, no significant difference was observed. ($p>0.05$). Decreasing of this trait means improvement because this trait is one of seven negative traits studied in the 27 studied traits in this research.

**The comparison of performance of single selection system in base population and response to selection for trait of hatchability percentage in autumn:** The selection in base population based on hatchability percentage in autumn during three generation in lines 32, 104 and 110 caused increasing this trait in amount of 0.151, 1.318 and 0.976%, respectively. With comparison carried out between responses to the selection of these three lines, no significant difference was observed ($p>0.05$).

**The comparison of performance of single selection system in base population and response to selection for trait of total produced eggs number in autumn:** The selection in base population based on hatched eggs percentage in autumn during three generation in line 32and 110 caused increasing this trait in amount of 39.63 and 45.29%, respectively but decreased in line 104 in amount of -35.38 eggs. With comparison carried out between responses to the selection of these three lines, no significant difference was observed ($p>0.05$).

## DISCUSSION

Breeding success of silkworm breeds stronger and superior to the separation of different genetic resources through collection, identification and mixing depends. Strong races can act as a pure online or as part of a cross, access and variety are mixed. If in a population, no selection was not done in a long time is the most quantitative traits in their populations whether in terms of how genetic and environmental components of diversity will show. When the same population, repeatedly a particular phenotype is selected, genetic factors quickly faded and environmental factors are causing the most phenotypic variation. But in any case, the population was not genetically uniform. In fact due to the, phenomenon of genetic continuity and the existence percent lower spontaneous mutations, the changes will continue (Seidavi and Bizhannia, 2008). In livestock breeding systems, selection criteria of some traits, independent of time and due to the optimization objectives considered race and could be different. Overally, genetic studies on the silkworm and appropriate corrective done.

Yet many of the principles and theories of breeding little should conditions on the existing lines of silkworm be tested and the results be measured in real terms and the right decision based on facts should be made available (Seidavi and Bizhannia, 2008). Potentially achieve more silkworm generations between races usually from two streaks of two varieties with yields above quantitative generation traits (polygenetic traits) and fitness traits as the right choice of potential and are very important parents homozygous (Rao *et al*., 2004). In Pakistan, about 11 researches on silkworm pure lines as resources for identifying the various and important economic traits and to hybridize and other breeding programs has been done (Hussain *et al*., 2010). Total 11 silkworm pure lines have been selected for commercial and industrial education came into effect in that they can be used as parents of future generations. The main goal of this research was to develop easy silkworm larvae that have strong with the best quality and highest production rate (high quantity). When the larvae have strong, growing to be too easy.

## CONCLUSION

Separation of effects in spring and fall seasons and compare responses to a choice of three lines of the above actions season effect showed that spring effects on three traits of 27 trait and autumn effect on four traits of these traits was significant statistically. Individual selection performance comparisons in base population of above three commercial lines based on cocoon weight and response to selected three lines for 27 traits examined in this study showed that spring effect on three traits of 27 studied traits is significant and the autumn on the four traits have significant effects. It is suggested that other researchers will continue this research on other commercial lines in future breeding programs in silkworm research center. We can estimate other effects such as season, generation, line and so on. It should be due to environmental changes, this research should be repeated.

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