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Field acceptability of improved grape pruning secateurs by grape orchard worker in grape cultivation activities

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Abstract
The aim of this study was to find out the field acceptability of improved grape pruning secateurs by grape orchard worker in grape cultivation activities. Physical fitness was determined by calculating the physical parameters i.e. height, weight, BMI, body composition, VO_2 max(ml / kgxmin), Body temperature, blood pressure, pulse rate, pulse pressure(mm/hg). The research designs comprised Ergo solution were developed in department of FRM and for testing and feedback of ergo solution. one orchard was selected randomly from the orchards selected in phase- II. An ergonomic experiment was carried out on 10 respondents, selected in phase II to find the feasibility of modified and developed ergo solution. This phase was carried out in sub-stages described as follows, Modification of existing grape pruning secateurs. The secateurs were used widely for the pruning and harvesting of grapes by the workers. The use of secateurs for long time resulted in grip fatigue and pain mainly in wrist, arm, palm and finger as reported by the respondents in Phase-II. To overcome these problems, the existing secateurs were modified in two ways. Covering the handle / hand grip of secateurs with plastic pipe, Covering the handle / hand grip of secateurs with raxin cloth. Conclusively on the basis of results of phase II pruning and harvesting of the grapes were identified as the highly risk prone activities. So available technology used by them was modified of existing grape pruning secateurs.

Keywords: grape cultivation, grape pruning, grape harvesting, secateurs, orchards workers

Introduction
Grape (*Vitis vinifera* L.) is an important fruit crop in India. Grapes are the third most widely cultivated fruit after citrus and banana. Major grape-growing states are Maharashtra, Karnataka, Andhra- Pradesh, Tamil Nadu and the north- western region covering Punjab, Haryana, Delhi, western, Uttar Pradesh, Rajasthan and Madhya Pradesh (Singh, 2010) [12]. In Haryana grapes are cultivated in an area of 111.00 (000 ha) with a total production of 1235.00 (Tons) and productivity of 11.10 (tons/ha) in 2010-11 (National Horticultural Board, Government of India). Haryana is the sixth largest producers of grapes in the country with 5.7 million ton/hectare/ year. Grape cultivation is grown under a variety of soil and climatic conditions (Shikhamany 2001) [11]. According to the International Labor Organization, the agricultural sector is one of the most hazardous sectors. Agricultural workers involve several strenuous activities like ploughing, spading, carrying, uprooting, planting, weeding, cutting, shafting, threshing, sweeping, etc. Musculoskeletal disorders were common among farmers. Grape cultivation is one of the agricultural activities. Grape cultivation involves various activities like land preparation, irrigation, manuring, pruning, harvesting, transportation etc. Grape production is very labor intensive operation i.e. Grape vineyard workers faces high stress on the hands during pruning of the grapevines under highly repetitive conditions (8 to 10 week period of intense and fast-paced work) and also the cumulated duration of exposure over the entire day was high, i.e. approximately 8 to 10 hours per day over a 4-month period. The frequencies of cuts, the pruning task were highly repetitive, and vineyard worker more autonomy than industrial workers and can modulate their rhythm of works and takes break they need. The use of pesticides and fertilizers in grape cultivation is a common everyday practice. It was found that pesticide crop sprayers were more likely to report work-related skin symptoms, asthma and other respiratory health problems among farm workers (Jeebhay *et al.* 2002) [6]. Pruning and harvesting was one of the most expensive and labor consuming, process. Several manual tasks performed with a cutting tool such as tie vine shoots, spring pruning, pruning, remove grapes, harvesting. There was stereotype work movements of hands are made up to 37 thousand per a shift.

Pruning imposes high biomechanical strains on the hand–wrist and repetitiveness of the task. Physical exposure during pruning activity the high prevalence of hand disorders among vineyard workers. The use of ergonomic pruning shears is advised to lower force exertion and to reduce the frequency of awkward wrist postures during pruning. Vineyard workers may risk back and the upper extremity injury during occupational tasks such as harvesting, pruning, and shovel weeding due to the postural demands and repetitive performance associated with these activities**.** Pruning of wine grape vines have also been found to have awkward postures of the shoulders. Hand pruning of vines requires the frequent squeezing of the hand to engage a clipper, or the frequent use of a knife. Hazards from the knife are obvious, as there is no solid surface against which to place the vine, shoot or stalk and frequent cuts to the fingers, hands, arms, legs and feet are likely to result. Clipper is the preferred tool for pruning; the major safety hazard is the threat of cuts from contact with the open blade while placing a vine or stalk in the jaws, or from inadvertent cutting of a finger while also cutting a vine or stalk. The frequency and effort required for cutting determines the likelihood of development of cumulative-trauma injuries. The force required to operate a common clipper is in excess of recommended values, and the frequency of effort indicates the potential for cumulative-trauma disorders, according to accepted guidelines. Kaur and Sharma (2010) [7] conducted ergonomic evaluation of vegetable plucking activity with traditional (ordinary knife) and improved tool (ring cutter). Ergonomic assessment of both the methods showed that by using ring cutter physiological and muscular stress of workers in terms of heart rate, energy expenditure rate, and physiological cost of work and grip fatigue was reduced as compared to traditional method. Thus, new tool i.e. ring cutter was found to be beneficial to improve work efficiency of farm women. Ghany *et al.* (2015) [4] studied that prickly pear (Cactus) was one of the important plants for sustainable development at arid region. Enhancing picking process and reducing microbial spoilage incident during hand picking, a fundamental goal to face obstacles was spread planting. Due to fruits and cladodes restrictive properties (physical and mechanical), an ergonomic pruning shear was developed to pick fruits. Results showed that using developed aid had a significant effect ($P < 0.05$) on labour productivity and picking cost compared with hand picking. Picking by developed aid increased productivity about 7.2% and decreased cost about 0.04kg. So keeping in mind the working pattern and working conditions the present study was under taken the field acceptability of improved grape pruning secateurs by grape orchard worker in grape cultivation activities.

Materials and Methods

A sample of 10 respondents was selected purposively from the randomly selected 2 grape orchards. Physical fitness of the workers involved in grapes cultivation activity was ascertained by measuring the parameters i.e. height, weight, BMI, body composition, VO_2 max(ml/kgxmin), Body temperature, blood pressure, pulse rate, pulse pressure(mm/hg). height, weight, BMI, body composition, VO_2 max(ml/kgxmin), Ectomorphic, Mesomorphic type body, Body temperature, blood pressure, pulse rate, pulse pressure(mm/hg). The height was measured using a stadiometer. A stadiometer is a piece of medical equipment used for measuring height. The stadiometer has a measuring range. Body weight: An accurate portable weighing machine was used for the study to take the weight of the orchards workers. The subject was asked to stand straight on the balance and the weight was recorded in kg with an accuracy of 0.1kg. BODY MASS INDEX: The condition of the workers was assessed by specifying the different degrees of the underweight expressed as the body mass index(BMI),the weight and height measures was used to calculate the BMI of respondents. Weight in (kg)/ Height in (m^2) (Garrow, 1981) [3] the Body mass index was calculated using the standard formula. Accordingly, the health status was defined as follows: i) BMI 20–24.9 (normal); ii) BMI 25–29.9 (overweight); and iii) BMI ≥ 30 (obesity). Estimation of body composition was determined from skin fold thickness at four sites i.e., biceps, tricep, subscapular and supreilliac with the help of skin fold caliper by using the methods proposed by Durnin and Rahman (1967) [2]. The lean body mass was assessed with the help of the following formula.

LBM (Kg) = Body weight – Fat weight

$$\text{Fat weight} = \frac{\text{Body weight x \% fat.}}{100}$$

% fat = (4.95 /D - 4.5) x 100
Where D is body density.
Body density= 1.1599 - (0.0717 x log of sum of four skin folds)

Maximum aerobic capacity (VO_2 max) was on the basis of physical fitness is the term which denotes an individual ability to accomplish a given task in a given period of time aerobically with maximum utilization of oxygen possible. It is also Known as maximum aerobic capacity and abbreviated as VO_2 max. The maximum aerobic capacity is considered as the best measures for the individual cardio respiratory fitness or capability of doing work Varghese *et al.* (1994) [13]. The formula was based on the relationship between age and body weight as they have great influence on VO_2 max.
(VO_2 max) = VO_2 (1/min) = 0.023 × body weight (Kg) – 0.034 × age (year) + 1.652
(VO_2 max) (Ml/kg × min) = VO_2 max (1/min/ Body weight (Kg.) × 10000
Blood pressure and pulse rate was standardized through sphygmomanometer and stethoscope and digital blood pressure, body temperature was measured by using clinical thermometer, Body temperature for three minutes- not above 99%, blood pressure-120/80± 10, and Heart rate-70-90 b-min.
Pulse pressure = Systolic pressure- Diastolic pressure
Average mean pressure = Diastolic pressure + 1/3rd of pulse pressure

Modifications in existing grape pruning secateurs

On the basis of results of Phase II pruning and harvesting of the grapes were identified as the highly risk prone activities. So available technology used by them was modified and ergo solution was developed for these two activities. A Secateurs were modified by adding the materials on grip / handle. The acceptability and feasibility of Grape secateurs for pruning and harvesting was assessed. The secateurs were used widely for the pruning and harvesting of grapes by the workers. The use of secateurs for long time resulted in grip fatigue and pain mainly in wrist, arm, palm and finger as reported by the respondents in Phase-II.

To overcome these problems, the existing secateur were modified in two ways.

- Covering the handle / hand grip of scateur with plastic pipe
- Covering the handle / hand grip of scateur with raxin cloth

Plastic pipe covered scateur

Raxin cloth covered scateur

Plat 1: Modifications in existing grape pruning secateurs

In the present context, feasibility has been defined as the extent to which workers have considered the (pruning and harvesting and grape pruning secateurs) in terms of different attributes namely i.e profitability, physical compatibility, cultural compatibility, simplicity, triability, grip fatigue, physical stress factor, work output, tool factor and acceptability. The responses of the workers were recorded on 5 Point scale. The quantifying scores for positive statements were quantified by assigning scores i.e.

- Strongly agree-5
- Agree-4
- Undecided -3
- Disagree-2
- Strongly disagree-1

For quantifying negative statements the scoring was as follows-

- Strongly agree-1
- Agree-2
- Undecided-3
- Disagree-4
- Strongly disagree-5

The mean scores were calculated for each category of statements and attained score were calculated by summation of the mean scores of different statements under each heading. The percentage of maximum attainable score was calculated by using the following formula:

$$\text{Feasibility index: } \frac{\text{E (P+Pc+Cc+ Sc+ Tc+ Gf+ PF+ Wo+ Tf+ Ac)}}{\text{P (P+Pc+Cc+ Sc+ Tc+ Gf+ PF+ Wo+ Tf+ Ac}} \times 100$$

Where,

E (P+Pc+Cc+ Sc+ Tc+ Gf+ PF+ Wo+ Tf+ Ac) is excepted score of profitability, physical compatible, cultural compatible, simplicity, triability, grip fatigue, Physical stress factor, work output, tool factor, acceptability.

P(P+Pc+Cc+ Sc+ Tc+ Gf+ PF+ Wo+ Tf+ Ac is perceived score of profitability, physical compatible, cultural compatible, simplicity, triability, grip fatigue, physical stress factor, work output, tool factor, acceptability

Results and Discussion

Physical characteristics of workers involved in grape cultivation

Mean height and weight of grape workers involved in grape was 159.9 cm and 64.2 kg respectively. Body mass Index (BMI) was observed as 21.8 Kg/m^2. Fat percentage was worked out to be 29.9 per cent. Hence LBM (Lean body mass) was 44.1 kg with variation of ±19.3kg. Aerobic capacity (VO_2 max) was found to be 31.8 ml/kg.×min exhibiting that the subjects were having good health

Table 1: Personal profile and health status of the selected respondents (n=15)

Physical Characteristics		Mean ± SD
Height(cm)		159.9± 8.8
Weight(Kg)		64.2±4.7
BMI (kg/m^2)		21.8±1.1
Body composition	Fat percentage (%)	29.9±5.9
	Lean body mass(kg)	44.1±19.3
Vo_2 max(ml/kg.×min)		31.8±6.3

Health status of workers involved in grape cultivation

In order to avoid any experimental error and to maintain the uniformity in data, only those workers were selected for the experimental study that had high average to good health status. It was clear from the table 2 that the mean body temperature was 98.6±0.33, blood pressure was systolic (mm/Hg)125.6±10.3, diastolic (mm/Hg) 80.3±4.8, pulse rate was 86.8±9.3bpm and pulse pressure was 45.7±4.2 mm/Hg. All the variables were in the normal range.

Table 2: Health status of workers involved in grape cultivation (n=15)

Variables of health status	Observed values	Recommended value	Category
Body temperature(^{0}F)	98.68±0.33	98.4degree F	Normal
Blood pressure: Systolic(mm/Hg) Diastolic(mm/Hg)	 125.69±10.36 80.38±4.89	 120mm/Hg 80mm/Hg	Normal
Pulse rate(bpm)	86.8±9.36	70-80bpm	Normal
Pulse pressure (mm/Hg)	45.7±4.2	30-50mm/Hg	Normal

Acceptability of improved grape pruning secateurs by orchard workers

The Acceptability of improved grape pruning secateurs was obtained from 10 grape orchard workers. Ranks were computed on the basis of mean score obtained in the following parameters and has been presents in table 3

'Liked the appearance, 'pruning can be done in proper way' and 'multipurpose in usage secured' 1st rank with (mean score 3.0). 'Increased coverage area under harvesting' and 'pruning got 2nd rank with (mean score2.9). 'Comfortable size and shape of the grip while using' secured 3rd rank with (mean score 2.8) followed by the 'good replacement of the existing tool and technique' (mean score 2.7), 'able to maintained comfortable body posture in standing position while using modified scateurs' (mean score 2.6), 'minimum twisting of trunk while doing the activity' (mean score 2.5), 'However restrained movements of hands' scored mean score of 2.2 and last rank was secured by ' coarse hard and unsuitable grip'

(mean score 1.) Janowitz *et al.* (2000) [1] reported that utilizing smaller and lighter weight bins during the harvesting of wine grapes. These intervention tubs reduced the weight by 12%, reduced the horizontal moment of arm by reducing the depth of the bins, included handles, and had smooth bottoms that reduced the sliding forces by 32%. Based on the NIOSH lifting guide, the lifting risk was reduced by 23% for the intervention tubs versus traditional tubs with virtually no difference in productivity.

Table 3: Acceptability of improved grape pruning secateurs by orchard worker (n=10)

S. No	Parameters	Mean score	Rank
1	Liked the appearance	3.0	1
2	Comfortable size and shape of the grip	2.8	3
3	Easy to work as hand grips were convenient	3.0	1
4	Soft and suitable grip	1.0	8
5	Minimum twisting of trunk while doing the activity	2.5	6
6	Maintained comfortable body posture at standing position	2.6	5
7	Restrained movements of hands	2.2	7
8	Increased coverage area under harvesting and pruning	2.9	2
9	Good replacement to the existing tool and technique	2.7	4
10	Pruning can be done in proper way	3.0	1
11	Multipurpose in usage	3.0	1
12	Acceptability for use	3.5	1

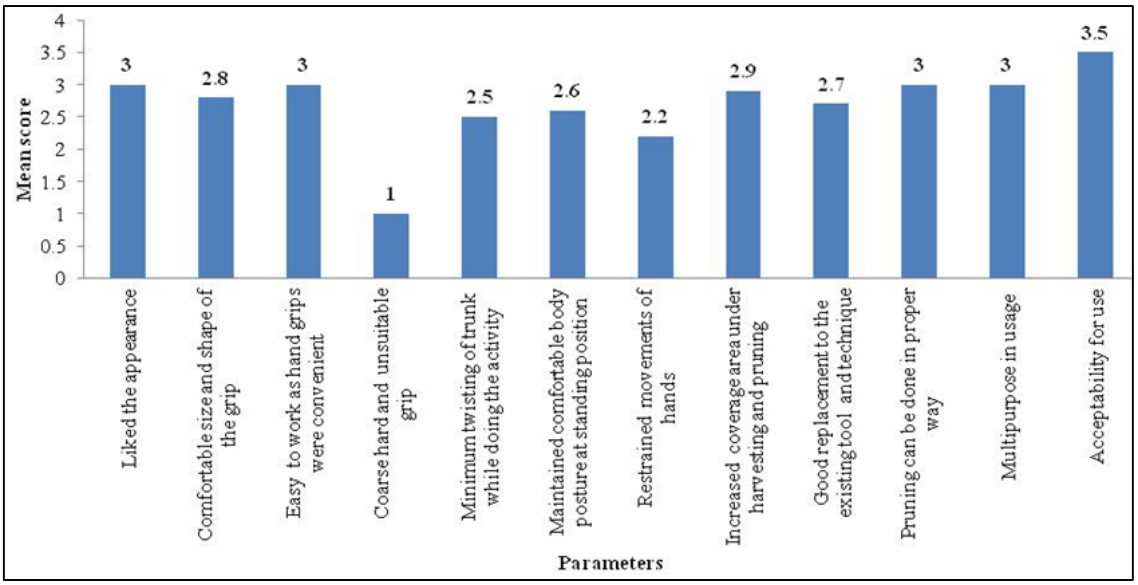

Fig 2: Acceptability of improved grape pruning secateurs by orchard worker

Feasibility of improved grape pruning secateurs

Tables 4 depicts the feasibility of improved grape pruning secateurs in terms of profitability, physical compatibility, cultural compatibility, simplicity, traibility, grip fatigue, physical stress factor, work output, tool factor and acceptability.

Profitability: Table revealed that (80%) of the respondents considered improved grape pruning secateurs as most feasible, 10 percent each considered it as feasible and somewhat feasible, technology for pruning of grapes in terms of profitability

Physical compatibility: In terms of physical compatability majority of the respondents (90%) considered improved grape pruning secateurs as most feasible and remaining 10 percent considered it as feasible technology.

Cultural compatibility: Table 4 revealed that regarding cultural compatability 40% of the respondents considered improved grape pruning secateurs as most feasible, 60 percent respondents considered it as feasible technology.

Simplicity: Most of the respondents (80%) considered the improved grape pruning secater as most simple and rest of 20 percent respondents considered it as simple technology for grape pruning.

Triability: Half of the respondents considered it as most feasible followed by 30 percent who considered it as feasible and 20 percent considered it as somewhat feasible technology for triability

Grip fatigue: Table 4 further concluded that 80 percent of the respondents considered grape pruning secateurs it as most feasible, 10 percent each considered it as feasible and somewhat feasible, grape pruning technology in regards to grip fatigue

Physical stress factor: Table 4 reveals that for physical stress factor 40% of the respondents considered grape pruning secateurs it as most feasible, half of the respondents considered it as feasible and 10 percent respondents considered it somewhat feasible technology for grape pruning.

Work output: Majority of the respondents (80%) considered improved grape pruning secateur as most feasible and remaining 20 percent respondents considered as it feasible technology for workoutput

Tool factor: Most of the respondents 70% considered grape pruning secateurs as most feasible, and rest of (30%) respondents considered it feasible technology for pruning of grapes in terms of tool factor.

Acceptability: Cent percent of respondents considered grape pruning secateurs as most feasible, technology for grape pruning.

It is clear from table that, Overall feasibility of improved grape pruning secateurs was maximum (71.0%) as most feasible followed by feasible (24%) and somewhat feasible (5%), as grape pruning technology. Similarly Duraj *et al.* (2000) [5] found that the impact of a tub cart for the transferring of tubs between fields and truck or collector bin. Workers had better postures i.e back flexion, and knees only slightly bent.

Table 4: Feasibility of improved grape pruning secateurs (n=10)

S. No	Feasibility	Most feasible	Feasible	Somewhat feasible
1.	Profitability	8(80)	1(10)	1(10)
2.	Physical compatibility	9(90)	1(10)	-
3.	Cultural compatibility	4(40)	6(60)	-
4.	Simplicity	8(80)	2(20)	-
5.	Triability	5(50)	3(30)	2(20)
6.	Grip fatigue	8(0)	1(10)	1(10)
7.	Physical stress factor	4(40)	5(50)	1(10)
8.	Work output	8(80)	2(20)	-
9.	Tool factor	7(70)	3(30)	-
10.	Acceptability	10(10)	-	-
	Overall n=100	71(71.0)	24(24.0)	5(5.0)

Feasibility index of improved grape pruning secateurs

Feasibility index was assessed in terms of profitability, physical compatibility, cultural compatibility, simplicity, triability, grip fatigue, physical stress factor, work output factor, tool factor and acceptability and presented in table 5

Feasibility Index: Tables 5 reveals that acceptability got first rank with feasibility index of 100%. Physical compatibility got 2nd rank with feasibility index of 98 percent followed by simplicity and work output factor each with feasibility index of 96 percent and 3rd rank, Grip fatigue and tool factor each got feasibility index 94 per cent with 4th rank. Cultural compatibility and profitability got 5th rank with feasibility index of 88%. The last rank was for triability and physical stress factor with feasibility index of 86 percent. Overall feasibility index of improved grape pruning sceateurs 93.2%, which was on higher side indicate that it was acceptable to user. Newenhouse *et al.* (2005) [10] reported that electric pruners were maximum potential to save labor about 20% and they cost approximately $1,500. Similarly NIOSH (2001) found that simple ergonomics solutions for farm workers are extended lifting tool for picking up plants in containers that reduces severe forward flexion of the trunk and eliminates pinch grip of hand, weeding stand for nursery workers who weed potted plants that reduces prolonged stooping and neck flexion, standard picking bins with handles that reduces the weight lifted and provides better grasping surface, a lighter-weight berry harvesting rake that reduces prolonged stoop postures and reduces weight of the rake, a packing shed layout that adjusts the work area to the farm worker and increases productivity.

Table 5: Feasibility index improved grape pruning secateurs (n=10)

S. No	Feasibility	Total	Feasibility index	Rank
1	Profitability	47	94	IV
2	Physical compatibility	49	98	II
3	Cultural compatibility	44	88	V
4	Simplicity	48	96	III
5	Triability	43	86	VI
6	Grip fatigue	47	94	IV
7	Physical stress factor	43	86	VI
8	Work output factor	48	96	III
9	Tool factor	47	94	IV
10	Acceptability	50	100	I
		466	(93.2%)	

Conclusion

- Mean height and weight of grape workers involved in grape cultivation was 159.9 cm and 64.2 kg respectively. Body mass Index (BMI) was observed as 21.8 Kg/m^2. Fat percentage was worked out to be 29.9 per cent. Hence LBM (Lean body mass) was 44.1 kg with variation of ±19.3kg.
- On the basis of results of Phase II pruning and harvesting of the grapes were identified as the highly risk prone activities. So available technology used by them was modified and ergo solution was developed for these two activities. Available technology i.e scateurs was modified by adding the materials on grip /handle.
- The Acceptability of improved grape pruning secateurs highlighted that appearances and easy to work as hand grips got highest rank.
- Feasibility index of grape pruning secateurs was 93.2% indicating that it was highly feasible for them to use.

References

1. Duraj V, Miles JA, Meyers JM, Faucett JA, Janowitz IL, Tarter ME, *et al*. Harvesting aids for reducing ergonomics risk factors in wine grape hand harvesting. Proceedings of the American Society of Agricultural Engineers Meeting, 2000.
2. Durnin J, Rahman M. The assessment of the amount of fat in the human body from measurements of skin folds thickness. British Journal of Nutrition. 1967; 21:681-688.
3. Garrow JS, Webster J. Quetelet;'s index as measures of fatness. International J of Obese. 1981; 9:147-153.
4. Ghany AEH, Ismail MA, Nahed K, Bialee ENM, El-Bialee NM. Developed hand tool to pick Prickly pear fruit. International Journal of Advanced Research. 2015; 3(5):1307-1315
5. Janowitz I, Tejeda DG, Miles JA, Duraj V, Fathallah F, Meyers JM, *et al*. Ergonomics interventions in the manual harvest of wine grapes. Proc. of the IEA 2000/HFES 2000 Congress, 2000.
6. Jeebhay MF, Baatjies R, Lopata AL. Occupational allergy among table grape farm workers in South Africa. Current Allergy and Clinical Immunology. 2002; 15(4):174-177.
7. Kaur H, Sharma S. Ergonomic evaluation of vegetable plucking with traditional and modern tool. Proceedings of HWWE, 2010, Chennai. 2010, 76. (Abstract).
8. National Horticultural Board, Government of India. Agriexchange, 2011. apeda.gov.in
9. National Institute for Occupational Safety and Health.

Simple Solutions Ergonomics for Farm Workers. Report. 2001, 1-53.
10. Newenhouse A, Miquelon M, Chapman L. Electronic pruners: faster and safer. University of Wisconsin, Madison: Healthy Farmers, Healthy Profits Project, 2005. http://bse.wisc.edu/hfhp/ tipsheets_html /pruner.htm
11. Shikhamany SD. Grape production in India. Grape Production in the Asia-Pacific Region, Minas K Papademetriou and Frank J Dent (Eds). FAO Regional Office for Asia and the Pacific, Thailand. 2001, 28-38.
12. Singh A. Recent Initiative in Horticulture, Westville Publishing House, Ist Edition. 2010, 2-4.
13. Varghese MA, Saha PN, Atrey N. A rapid appraisal of occupational work load from a modified scale of perceived exertion. Ergonomics. 1994p; 37:485-491.