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Studies on ergonomic problems in agricultural machinery operations

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Abstract : To identify the ergonomic problems encountered by the users during operation of various agricultural implements and machinery, a case study was undertaken in Trichy, Pudukkottai and Tiruvannamalai districts of Tamil Nadu by interviewing farmers using prestructured questionnaire. The ergonomical problems faced by the farmers were listed and analysed using Statistical Package of Social Science (SPPS), in terms of postural discomfort jerks/vibrations, pain on body parts, force required and drudgery involved. About 59 per cent of jerks/vibration occurred during initial ploughing operation. Hand tools required "too much" force in operation of animal drawn implements. About 86 per cent of farmers experienced drudgery in operating animal drawn implements whereas only. About 28 per cent of farmers felt drudgery with power operated equipment. Eye/skin irritation was experienced by 65 per cent of workers during pesticide application due to non-use of protective clothing, hand gloves, goggles etc. (**Key words** : Ergomic problems, postural discomfort jerks, Drudgery and Machinery)

Farm mechanization along with increased application of agricultural inputs has enhanced the productivity in Indian farms. But on the other hand it has also led to increased casualities and injuries due to accidents while carrying out different agricultural activities by machines. About 8 per cent of the farm power is contributed by about 200 million agricultural workers. They operate tractors, power tillers, self propelled machines and power operated machines. Therefore, the application of ergonomics in agriculture can help in increasing the efficiency and productivity of the workers without jeopardising their health. Ramamurthy and Balavady (1966) observed that puddling and bund trimming are the heaviest agricultural operations. Crolla (1976) reported that agricultural tractor ride vibration (vertical) levels were reduced upto 50 per cent in heavy and 30 per cent in light soil with five furrow plough. Nag et al. (1980) observed that weeding either in squatting or bending posture did not cause a marked difference in energy expenditure which is 11.20 KJ/min and 12.18 KJ/min respectively, but drudgery caused due to bending was reflected in terms of postural discomfort. Tewari and Datta (1983) reported that weeding blades with 150 to 200 mm working width in manual weeder will be within the human limitation. Ghugare *et al.* (1991) recommended improvement in the mounting of the sprayer on the operators back to reduce the postural discomfort. Yadav *et al.*, (1979) observed that rotary mode was more comfortable to the operator in paddy thresher.

A survery was undertaken in Tamil Nadu to identify the ergonomical problems among rural people in the operation of agricultural machinery and the results are presented in this paper.

Materials and Methods

Selection of study area

By random sampling, three districts, namely Trichy, Pudukkottai and Tiruvannamalai were selected in Tamil Nadu for this study. The data on availability of agricultural machinery and implemetns for these districts were collected from the Directorate of Statistics and Economics, Chennai. Three villages were selected from these three districts in such a way that they use agricultural machinery extensively for various operations in crop production and processing activities.

Sampling procedure

In a particular village, all the farmers were serially numbered. One hundred farmers were selected based on simple random sampling using the random number table. This procedure was carried out for selecting 100 farmers from each one of the villages. Therefore, this procedure will lead to a representative sample farmers from those villages in which the survey was undertaken. The data were collected as per the questionnaire prepared through personal interviews by contacting the persons on one to one basis. The data collected were coded and analysed using Statistical Package of Social Science (SPESS).

Results and Discussion

The ergonomical problems encountered in different agricultural operations were collected from

the farmers in villages and analysed in accordance with the activities associated with the agricultural implements..

Tractor and its matching equipment

Tractor trailer, cultivator, disc plough, cage wheel and mould board plough are the major matching equipment to tractors available with the farmers of Tamil Nadu. The ergonomic problems as observed by the farmers are furnished in Table 1. While operating the above equipment, 65.0 per cent operators expressed postural discomfort 'often'. 'Severe' jerks / vibrations were expressed by 24.0 per cent of operators while 44.3 per cent of operators experienced a 'lot of jerks/ vibrations during tractor operation. The major operations which caused more of jerks/vibrations is initial ploughing (59.0%). Buttock pain was expressed by 31.7 per cent of operators while 15.7 per cent of operators expressed stomach pain during operation of tractor operated equipment. The stomach pain might be due to the acidity formation due to the vibration while the buttock pain may be due to postural discomfort.

About 91.2 per cent of tractor operators were satisfied with the present locations of the controls. Regarding the operations of the controls, 54.3 per cent of operators found difficulty with brakes and 22.7 per cent of operators expressed difficulty with gear shift lever. Of course, difficulty in operation of other controls were expressed by less than 12.3 per cent of operators (Table 2). More than 83.5 per cent of operators expressed that all the controls required more force when compared to domestic vehicles, which caused pains in different parts of the body.

Hand tools/manually operated equipment

About 61.3 per cent of farmers expressed that "too much" force is required for operating hand tools, while 30.7 per cent of farmers informed that "a lot" of force is required for operating hand tools. About 52.0 per cent of farmers are suffering from back pain while 29.3 per cent of farmers are suffering from knee joint pain. The pain is due to inconvenient position of the farmers in using the hand tools (Table 3).

Animal drawn equipment

About 50.7 per cent of farmers experienced 'too much' of drudgery while 35.3 per cent of farmers have 'a lot' of drudgery in operation of animal drawn equipment (Table 4). About 41.3 per cent of farmers expressed that "too much" force is required for operating these equipment.

Power operated equipment

Table 5 shows that "some" drudgery is experienced by 68.3 per cent of farmers while only 27.3 per cent experienced 'a lot' of drudgery while operating these equipments. While comparing animal drawn equipment and power operated equipment based on drudgery involved, only 0.3 per cent of farmers face "too much" drudgery in power operated equipment whereas 50.7 per cent of farmer face the same in case of animal drawn equipment.

Overall perception of agricultural workers on ergonomics of agricultural operations

About 69.7 per cent of workers expressed muscular fatigue due to lifting of crop for threshing while 65.0 per cent of workers have eye/skin irritation due to pesticide application (Table 6). Digging with spade induced waist pain as perceived by 60.0 per cent of workers, while leg fatigue is experienced in walking behind the plough as perceived by 56.3 per cent of workers. Other major problems expressed by the workers induced waist pain during rice transplanting (49.0%), hand abrasion while hand decortication of groundnut (43.4%) and muscular fatigue during weeding operation (42.7%). Most of the body pain caused in performing agricultural operations is due to postural discomfort as in digging with spade, rice transplanting, manual weeding etc. The eye/skin irritation during pesticide application is due to improper protection clothing, non-use of safety devices like goggles, hand gloves, etc.

Conclusions

The tractor manufactuers can aim in reducing the vibration especially in the steering and seat which is the major ergonomic problem faced by tractor operators. The awareness of users on ergonomical aspects in agricultural machinery design and operation should gauged through mass media and training programmes.

Table 1. Operator's response for jerks/vibrations

Sl. No.	Particulars		Operators response (%) District			Average (%)
			I	II	II	
1.	Frequency of adopting twisted/awkward posture	Very often	33	24	38	31.7
		Often	31	38	31	33.3
		Sometimes	30	38	30	32.7
		Rarely	6	0	1	3.2
		Never	0	0	0	0.0
2.	Severity of Jerks/vibration	Severe	21	34	17	24.0
		A Lot	41	48	44	44.3
		Mild	38	18	39	31.7
		No	0	0	0.0	
3.	Types of operation	Ploughing Cultivated land	10	16	12	12.7
		Ploughing unlevelled land	80	48	49	59.0
		Road marching	8	24	27	19.7
		Others	2	12	12	8.7
4.	Pain in different parts of body	Buttock	51	16	28	31.7
		Stomach	20	4	23	15.7
		Back	11	0	9	6.7
		Legs	7	0	2	3.0
		Hands	8	0	0	2.7
		Neck	0	8	6	4.7
		Eyes	2	2	2	2.0
		Ears	1	3	5	3.0
		Shoulder	0	10	12	7.3
		Waist	10	0	8	6.0
		Knee	3	0	6	3.0

District I : Trichy District II :Pudukkotai District III : Tiruvannamalai

Table 2. Problem in operation of controls

Sl .No.	Controls	Per cent response I	II	III	Average (%)
1.	Cluth	4	9	12	8.3
2.	Steering	3	2	9	4.7
3.	Gear shift lever	8	39	21	22.7
4.	Brakes	48	56	59	54.3
5.	Accelerator	3	0	8	3.7
6.	Hydraulic lever	0	21	16	12.3
7.	Control panel	3	7	8	6.0
8.	PTO lever	0	0	0	0.0
9.	Gear lever	4	0	2	2.0
10.	Ignition & lighet	19	4	9	7.7
11.	Switches	12	6	6	8.0

Table 3. Operator's response on hand tool

Sl.No.	Particulars		Per cent response I	II	III	Average (%)
1.	Force required in operation	Too much	48	88	48	61.3
		A lot	44	12	36	30.7
		Some	8	0	16	8.0
		No	0	0	0	0.0
2.	Pain in body part during operation	Back	60	40	56	52.0
		Knee joint	28	28	32	29.3
		Arm Joint	12	0	8	6.7
		Others	0	32	4	12.0

Table 4. Operator's response on animal drawn equipment

Sl.No.	Particulars		Per cent response I	II	III	Average (%)
1.	Drudgery occurred	Too much	64	56	32	50.7
		A lot	23	31	52	35.3
		Some	13	13	16	14.0
		No	0	0	0	0.0
2.	Force applied by operator	Too much	48	32	44	41.3
		OK	38	49	48	45.0
		Very little	14	19	8	13.6

Table 5. Drudgery with power operated equipment

Sl.No.	Drudgery involved	Per cent response I	II	III	Average (%)
1.	Too much	0	1	0	0.3
2.	A lot	30	14	38	23.7
3.	Some	70	75	60	68.3
4.	No	0	10	2	4.0

Table 6. Overall perception of agricultural workers on farm operations

Sl.No.	Drudgery/health hazard	% expressed pain I	II	III	Average (%)
1.	Waist pain due to digging with spade	72	50	58	60.00
2.	Waist pain due to rice transplanting	49	60	38	49.0
3.	Hand abrasion due to hand decortication of ground nut	43	46	41	43.3
4.	Leg fatigue due to walking behind the plough	53	60	56	56.3
5.	Eye skin irritation, dizziness due to pesticide application	71	55	69	65.0
6.	Stomach ailment due to tractor vibration	34	18	29	27.0
7.	Hearing problem due to tractor noice	18	8	20	15.3
8.	Hand ailments due to power tiller handle vibration	23	27	24	24.7
9.	Hearing problem due to power tiller noice	16	20	27	21.0
10.	Muscular faitigue due to weeding operation	48	41	39	42.7
11.	Muscular fatigue due to lifting of crop for threshing	19	30	21	69.7
12.	Accident probability in threshing	19	30	21	23.3
13.	Throat/cough problems due to dust in threshing operation	29	32	23	28.0

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Character association studies in blackgram (*Vigna mungo* (L) Hepper)

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Abstract : Character association analysis in fifty genetically diverse genotypes of blackgram revealed significant positive association of biological yield per plant, pods per plant, clusters per plant, branches per plant, plant height, harvest index and days to maturity with grain yield in decreasing order of their magnitude. Further, it was found that biological yield per plant, harvest index and pods per plant showed high direct effects on grain yield where as high indirect positive effects were shown by other traits through biological yield per plant, harvest index and pods per plant. Hence, these characters appeared to be important for evolving superior genotypes in blackgram. *(Key words :* Blackgram, Genotypic & Phenotypic Correlation, Path analysis, Yield components).

Character association analysis reveals the type, nature and magnitude of correlation between yield components with yield and among themselves. Genotypic correlation is the correlation of breeding valus i.e. (Additive + Additive gene action). A knowledge of inter-relationships existing among yield components is essential when selection for improvement is to be effective. Path analysis identifies the yield components which directly and indirectly influence the yield. Hence, the present research work was carried out to study the correlation coefficients and path coefficients in order to formulate a selection criteria for evolving high yielding genotypes in blackgram.

Materials and Methods

Fifty genotypes of blackgram (*Vigna mungo* (L.) Hepper) obtained from Lam, Guntur were used in this experiment and were grown in a randomized block design with three replications at the wetland farm of S.V. Agricultural College, Tirupati during Rabi 1998. Each genotype was sown in a single row of 4.5 m length with a spacing of 30 cm in between the rows and 15 cm between plants within the rows. Observations were recorded on randomly selected five competitive plants in each genotype in each replication for all the characters except days to 50% flowering and days to maturity, which were recordd on per plot basis. Correlation and path coefficients were computed by following standard statistical procedures (Falconer, 1964; Dewey and Lu, 1959).

Results and Discussion