Stress Analysis of Cultivator : A Survey Approach

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Abstract - *In Recent years we have seen remarkable development in the field of agriculture. Big farmers are using advance machine tools now a days like harvester, cultivator, tractor. In India where 65-70% farmers are still doing farming traditionally. They also need improved agriculture tools. In this article we study on failure and analysis of nine tine cultivator in different soil conditions. As an important agriculture equipment for soil preparation cultivator is used in which stress are form due to contact with soil where tine works as actual member of cultivator which is direct contact with soil. We can reduce the stress from changing the design of tine of cultivator. This paper presents the works which have done on cultivator by using different techniques.*

1.INTRODUCTION

At the place of standard moldboard plows the cultivator sweeps are used for deep soil penetration. the loads act on the cultivator components can be very large and, in some cases, may be greater than the manufacturer anticipated in the original facts. This had been resulted in the need for a better understanding of which type of forces exist under such different operating conditions so that, if need, appropriate changes in design can be made. Some environmental issues related to use of herbicides, mechanical row crop cultivation is required as alternative methods of weed control. Excellent method of weed control is Crop cultivation [2,3,4]. There are basically three types of cultivators: field cultivators, row crop cultivators, and rotary cultivators [1]. Mostly Field cultivators are used as secondary tillage tools for preparation of seedbed. They are similar to chisel plows in appearance but they operate at much shallower depths. Cultivators used in residue-covered fields must allow residue to flow through the implement without clogging. In Figure 1 show different types of tools that can be attached to a cultivator shank for different applicationssre shown [1]. In 1940-1950s row crop cultivators were very important farm implements for cultivating between rows of crops such as corn and soybeans. These implements continued to be manufactured in the '60s and '70s and a new cultivator would be designed, Row crop cultivator. The cultivators manufactured during those years had some common characteristics. They had a unit frame with a single gauge wheel, a disk coulter behind the gauge wheel, and a middle worker behind the disk coulter generally and a provision for fenders or skirts to protect plants growing in the crop rows from soil thrown laterally by soil engaging tools. Space was provided between the coulter and the middle worker and between the gauge wheels and the coulter to allow residue lifted by the gauge wheel and by the coulter to fall back to the ground and to reduce plugging. There was variety of tools were employed as middle workers. The V-shaped middle worker tools was most commonly tool was a one-piece V-shaped sweep commonly employed on field cultivators and chisel plows. The spacing between the three-primary ground engaging components of each row unit resulted in the center of gravity of each row unit being spaced to the rear of a supporting tool bar some distance.

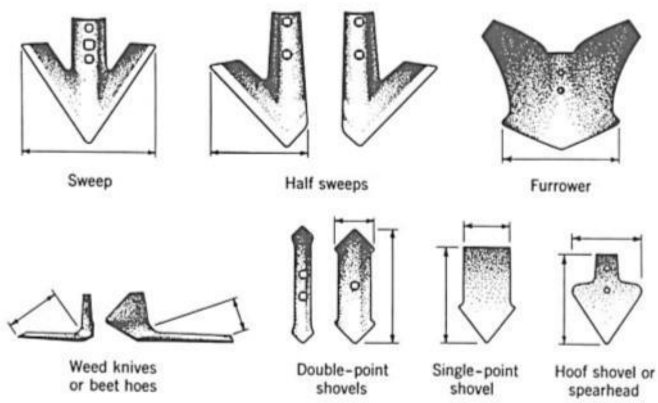

Fig 1: Cultivator Tools

1.1 Types of Cultivators [7]

Cultivators groups such as small, farm, field and row types can be described as

(A) Small cultivators: it is used for gardening, powered by small motors, and controlled by an operator walking behind. Garden cultivators can be used to mix soils with manures and fertilizers in preparation for planting.

B)Farm cultivators: A tractor-mounted tiller Cultivators are pulled by tractors and can vary greatly in size and shape, from 10 feet (3 m) to 80 feet (24 m) wide. Many are equipped with hydraulic wings that fold up to make road travel easier and safer.

C)Field cultivator: Field cultivators are utilized to finish culturing operations in numerous sorts of arable harvests fields. The principle capacity of the field cultivator is to set up an appropriate seedbed for the harvest to be planted into, to cover yield buildup in the dirt (warming the dirt before planting), to control weeds, and to blend and join the dirt to guarantee the developing product has enough water and supplements to develop well amid the developing season.

D)Row crop cultivator: The main function of the row crop cultivator is weed control between the rows of an established crop.

Types of cultivator on the basis of geometrical features

Disc cultivator: It is cultivator fitted with disc.

Tine cultivator: It is a type fitted with tines having blades.

Rotary cultivator: It is a cultivator with tines or blades mounted on a power driven-horizontal shaft. Depending upon type of power available for the implements, the cultivator can be classified as: 1. Tractor drawn 2. Animal drawn.

a) Trailed type cultivator: It consists of a main frame which carries a number of cross members to which tines are fitted. A pair of wheel is provided in the cultivator. The lift is operated by both wheels simultaneously so that draft remains even and uniform.

b) Mounted cultivator: Tractors fitted with hydraulic lift operate the mounted type cultivators.

c) Cultivator with spring loaded tines: A tine hinged to the frame and loaded with a spring so that it swings back when an obstacle is encountered, is called spring loaded tine.

d) Cultivator with rigid tines: Rigid tines of the cultivator are those tines which do not deflect during the work in the field.

e) Duck foot cultivator: It is type of rigid cultivator which is used mostly for shallow ploughing, destruction of weed and retention of moisture.

f) Animal drawn cultivator: Depending upon local conditions, soil and climate, different types of cultivators have been designed and are being used extensively throughout country. Three tined cultivators with seeding attachment are popular in some part of the country [7].

2. LITERATURE REVIEWS

Literature will give information about the Various cultivator and its Tyne the main focus is tyne analysis and Failure investigation.

H. Mark Hanna, Donald C. Erbach et.al. [2] concluded that the data from this experiment support the following conclusions for a single high-speed cultivation strategy in no-till corn production:

- A 38-cm (15-in.) herbicide band treatment had fewer weeds, less visual weed cover, and generally greater yield, extended leaf height, and corn population than did a 19 cm (7.5 in.) band.

- Few differences were noted comparing cultivator styles. Weed management and grain yield were as good or better with the traditional low-crown sweep as other styles. Its wider cutting width (56 cm or 22 in.) in 76 cm (30 in.) rows resulted in a lower corn population, however, when operated at 16.9 km/h (10.5 mph) with a crosswind.

- Weed population and visual weed cover after cultivation and late in the season were greater and corn grain yield was less in a no-herbicide, uncultivated control treatment.

- To maintain corn yield with a single cultivation strategy as compared to a broadcast only strategy, it is recommended to use a 38-cm (15-in.)-wide herbicide band. Cultivator style is less significant. Crop injury should be monitored as operational speed increases.

K. R. Paarlberg, R. G. Hartzler et.al. [3] Within the range of experimental conditions using a single cultivation in a continuous no-till corn system, the data support using a 38-cm (15-in.) wide herbicide band and cultivation speed of 11.2 km/h (7 mph). Choice of cultivator style is less apparent, although weed management and grain yield were improved somewhat with the use of disc hillers and a low-profile sweep such as a conventional low-crown sweep or smith fin. Weed management and grain yield using this cultivation and banding strategy is equivalent to that using a broadcast herbicide only strategy and offers an opportunity to reduce herbicide use and increase profitability.

Mehmet Topakci, H. Kursat Celik [10] This study was focused on the structural optimization of agricultural deep tillage machinery and tools by means of CAE applications. For this purpose, a case study was constructed and presented. A subsoiler which has three tines was used in the case study. According to the study, a number of points can be summarized as follows: 1. Maximum draft force of the subsoiler was calculated as 38.32 kN in the field experiments. This means that each tine has 12.773 kN maximum draft forces. 2. In the FEM stress analysis, the maximum equivalent stress was 432.490 MPa, and a total deflection of 18.116 mm was obtained on the initial design of the tine. When compared with the yield point of the tine material, the results signified that there was plastic deformation occurring on the tine. 3. A "what-if" parameter strategy was used in the optimization study and in total, 45 design sets were created and solved. After consideration of all of the results, design set number 34 was agreed as the optimum design of the tine under the defined conditions. 4. The final design of the tine has maximum global stress of 346.61 MPa and maximum total deflection of 12.116 mm. 5. Total mass of the tine was reduced by 0.367 kg, the equivalent of 2.01%.

G. C. Kiss, and D. G. Bellow [11] Extensive measurements on the forces involved in using sweep cultivators and spikes were undertaken at five different test sites at which depth and speed were varied with the following conclusions. 1. Draft force increased with depth of cultivation and could be approximated with an equation similar to that published by the American Society of Agricultural Engineers. Additional regression analysis is given to show the load distribution be tween leading and trailing sweeps and spikes. 2. The draft force of a trailing sweep was approximately 27% less than mea sured on the leading (and overlapping) sweep and the draft force of a spike was approximately 34% less than the draft force of a leading sweep. 3. Lateral and vertical forces were me asured up to 20% of the draft force. However, lateral forces were generally small or non-existant for leading sweeps and spikes. 4. Tool forces did not appear to be aff ected by speed in the range 6-12 km/h for the cultivator sweep evaluated. 5. Predominant frequencies of vibra tion of the implements tested were obs erved in the range 1 to 9 Hz. Although some peaks were noted at higher frequencies.

U. R. Badegaonkar, G. Dixit and K. K. Pathak [12] An increase in horizontal and vertical forces was observed with increasing depth for all experimental shanks having different bend length, bend angle and width. The analysis of variance showed that the effect of design parameters of shank and operational variables and their interactive effect on draft and vertical force was significant. Lateral forces were found to be negligible or non-existent. On the basis of minimum draft requirement, the optimum values of bend length and bend angle for cultivator shank were found to be 200 mm and 300 respectively. The width of shank was optimized as 35 mm, considering the advantage of width in minimizing the lateral bending of shank which may occur due to accidental lateral forces at the time of turning.

Gopal U. Shinde and Shyam R. Kajale [16] A rotary tillage tool such as Rotavator is designed in computer aided design software. The rotary motion and soil surface interaction is considered with respect to the soil Vs. tillage tool dynamics by considering the following factors effecting the tillage operation such as tractor power (hp), maximum peripheral force (N), rotavator tyne velocity (m/s), tractor transmission efficiency (0.9 for concurrent revolution and 0.8-0.9 for reversed rotary), soil resistance to 0.7-0.8, radius of rotary (mm). The design analysis executed following results[10]. The following Figure 2 shows the Resultant stress and displacement for 35 hp and 45 hp tractors along with safety coefficients. Maximum peripheral force on rotary blade 6031.08975 (for 35 hp) N and 7041.17 N (for 45 hp) Torque=270600 N-mm (for 35 hp) and 315920 N-mm

L.J. Niemand and J. Wannenburg [17] In terms of desirable stress the optimal design gives a remarkable improvement compared to that of the standard design. From a manufacturing point of view, the solution is feasible, since the manufacturer may use off-the-shelf spring steel flat bars. When the values of the angle 0s increases, the stiffness of section CD decreases and the stiffness of section AB increases accordingly. This ensures that the material in section CD contributes more to the deformation and load absorption. This new design lessens the stressing of the shank significantly and therefore leads to improved durability.

A. B. Tupkar and Partha Pratim Roy [18] Conclusion of the project work is that it helps the students to their imagination, engineering skills and fundamental knowledge. This semi-automatic machine is developed to reduce the time and effort required for production up to the great extent. also, this machine manufacturing cost is less as compared to other. By selecting above topic, we are understanding, familiar and know the details of agricultural technology, with the help of this semi-automatic machine we are trying to reduce labor cost, time of a middle class and small sector farmers. This is our little effort to make comfort to our farmers also this machine is manufactured in less cost as compared to other. The project also teaches the way of working as a unity proper coordination is to be established with student in the project group. it enhances the thinking or filling of mutual cooperation in the project Also the project tees learn to fabricate any model according to its requirements. All the manufacturing processes are carried out with a great concentration; any wrong calculation may have result in the failure of project model. Development of high capacity energy efficient versatile machines and combination machinery for increased labour productivity, reduced unit cost of operation, improved timeliness of operation and suitable for custom hiring.

Pooja M. Raut and G. V. Thakre [19] The analysis of Nine Tyne Medium Duty Cultivator is carried out to find out the failure in the shovel due to different loading condition at different speed. By conducting FEM analysis of existing model it has been observed that the shovel gets break due to impact force on the shovel of material En45 at very low speed. Accordingly, I change the material of shovel Boron

Steel it is suitable material for Shovel. Modern engineering tools like CAD, CAM, FEM, QFD and RP etc are the powerful tools for the manufacturing of improved agricultural tools. By using CAD/CAM technology visualization, Color selection, checking interference between mating parts of an assembly, Modifying and improvement in the models of the components become easy. Also, this technology helpful in preparing detailed component drawings and assembly drawings. By using FEM technology, it is possible to analyze correctly different type of stress which is going too developed on the product with the different loading condition. Also by applying this technology it is possible to overcome all the problem of intuitive manufacturing and produced the improved tools with good quality, improved life and cheaper in cost.

3. CONCLUSIONS

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