United States Department of Agriculture

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

CONTROLLED TRAFFIC FARMING

Code 334

(Ac.)

DEFINITION

Controlled traffic farming (CTF) is confining all wheel/track traffic from farm equipment (and in some cases, foot traffic) to specific lanes or tramlines (traffic patterns) in crop fields year after year.

PURPOSE

Improve soil health by limiting traffic compaction to designated traffic lanes.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to cropland where traffic can be limited to designated traffic lanes.

CRITERIA

For agronomic crop fields and other fields with mechanical operations only (i.e., no hand harvest or extensive foot traffic):

Limit wheel/track traffic to designated traffic lanes or traffic zones making up a total of no more than 33 percent (33%) of the field area. The remainder of the ground (67% or more of the field area) consists of grow zones that will never receive wheel/track traffic.

The designated traffic lanes or traffic zones must be used for all traffic continually (i.e., once the traffic pattern is established, no traffic is allowed on grow zones). The requirement to use designated traffic lanes or zones applies to all wheel/track traffic, regardless of axle loads or wheel loads. It also applies to all operators and implements, including custom applicators or harvesters, and their equipment.

Crops may be grown in traffic zones (and those crops may receive traffic). But the ground designated as grow zones and making up at least 67% of the field area will never receive wheel/track traffic.

For horticultural crop fields and other fields with hand harvest and other extensive foot traffic:

The following criteria apply only to fields in which horticultural and/or high-value crops are grown using (a) hand harvest or other operations resulting in extensive foot traffic and (b) one or more relatively wide drive lanes in the field that are not planted to the primary cash crop and are designated for hauling product out of the field, etc. (these drive lanes may be bare or planted to permanent or temporary cover crops).

Limit wheel, track, and foot traffic to designated traffic lanes or traffic zones making up a total of no more than 50% of the field area (drive lanes are considered traffic zones). The remainder of the ground (50% or more of the field area) consists of grow zones that will never receive traffic, including foot traffic.

The designated traffic lanes or traffic zones must be used for all traffic continually (i.e., once the traffic pattern is established, no traffic is allowed on grow zones). The requirement to use designated traffic lanes or zones applies to all foot and mechanical traffic, regardless of axle loads or wheel loads. It also applies to all operators and implements, including custom applicators or harvesters, and their equipment.

Crops may be grown in traffic zones (and those crops may receive traffic). But the ground designated as grow zones and making up at least 50% of the field area will never receive traffic, including foot traffic.

Additional criteria applicable to all fields:

Ensure that controlled traffic lanes are designed and used in a manner that avoids concentrated flow that may result in gully erosion.

Ideally, all tire and/or track widths will be narrow enough to fit in-between crop rows (i.e., no crop rows are trafficked). If this is not possible, then some crop rows may receive traffic, but the ground occupied by those rows is counted as part of the traffic zone. For example, if wheat is planted with a narrow drill-row spacing of 7.5 inches and we assume that all tires are wider than 7.5 inches, then traffic lanes may either be seeded to wheat (which will be trafficked by post-planting field operations) or may be skipped over at planting to create tramlines with no crops. In either case, the percentage of the field designated as traffic zone remains the same.

In order to minimize compaction and maximize vehicle traction and flotation in the traffic zone, tire-to-soil or track-to-soil pressures should be kept as low as possible. For wheeled vehicles, this means keeping inflation pressures as low as possible. Note that minimum safe inflation pressure for any particular tire can only be determined from manuals provided by the manufacturer; it is a function of the tire's design and the maximum expected load on and operating speed of the tire. Do not adjust inflation pressures without checking the manufacturer's recommendations.

If harvested crops are grown in traffic zones, inflation pressures for tires that run over that cropped area should be set below 18 psi (or theoretical equivalent psi for tracked vehicles) to reduce potential damage to the crop. As stated above, regardless of tire inflation pressure and vehicle-to-soil contact pressures, no traffic is allowed in designated grow zones.

Subsoiling grow zones immediately prior to establishing the new traffic pattern may be beneficial. Once the designated traffic pattern is established, subsoiling is typically counterproductive in traffic zones and unnecessary in grow zones. Therefore, once the traffic pattern is established, do not routinely till deeper than 4 inches. Deeper tillage for targeted agronomic purposes, such as under-row ripping ahead of tap-rooted crops in grow zones in soils with natural hardpans, may be acceptable on a case-by-case basis**.**

CONSIDERATIONS

General:

Controlled traffic takes advantage of soil compaction where it is beneficial and eliminates it where it is detrimental. Compacted soil in the traffic zone provides better carrying capacity, flotation, and traction, especially on wet soils. This in turn can improve access to the field and timeliness of key operations such as planting, harvesting, etc. Non-compacted soil in the grow zone leads to better root development, water infiltration, fertilizer uptake, etc. This in turn leads to better crops with less need for subsoiling or compaction-alleviating tillage. The combined effects of the above can significantly reduce fuel usage and lower overall horsepower requirements on the farm (allowing conversion to smaller tractors, etc.), as well as reduce runoff and erosion risk.

Controlled traffic can be implemented and can be beneficial in both tilled and no-till systems. It fits especially well in continuous no-till systems, in which there are few options for breaking up compaction after it occurs. It also can be a good fit for intensive vegetable farms or other operations that use permanent raised beds.

The two most obvious options for keeping equipment in the planned traffic pattern is a GPS-based precision guidance system or maintaining permanent raised beds. However, other creative options for maintaining traffic patterns are possible.

Controlled traffic may be very challenging to achieve, especially on farms with very diverse cropping systems, crop-livestock integration, small and/or irregularly-shaped fields, and steep/irregular topography. It can require rethinking and retooling an entire farm's worth of equipment, which requires significant time and expense. However, even if true controlled traffic can't be achieved, the process of analyzing traffic patterns and implementing even modest improvements can be beneficial.

Using low-pressure tires and keeping inflation pressures as low as possible for the load/job will help reduce compaction and tire-to-soil contact pressure. It will also generally improve traction and flotation.

Consider using a systems approach that integrates controlled traffic with other compaction-minimizing agronomic strategies. For example, continuous no-till, crop rotation, and cover crops can increase the number of permanent, stable macropores in the soil profile through enhanced soil biological activity.

Consider hitch offsets in no-till systems to avoid problems due to fertilization placement and/or planting in the exact same location in the grow zone year after year.

Smoothing out ruts and similar operations should be planned and carried out prior to establishing the controlled traffic system.

Controlled Traffic Planning Process

The controlled traffic planning process has one overarching goal: to make the number of traffic lanes required to farm the field as few as possible and as narrow as possible. The thought process involves the following four steps, regardless of the type of farm or scale of the operation.

1. Strive to make all equipment cover the same operating width, or multiples of that width. Also, maximize operating widths whenever possible. Matching and maximizing operating widths usually reduces the number of traffic lanes required to farm the field. For typical grain farms, the harvester is often the determining factor. For example, consider a combine with 12 row corn head (30 feet wide) and 30 foot grain head. Ideally, the row crop planter and grain drill would both be 30 feet wide and the sprayer would be 90 feet wide. Many other combinations are possible, but this setup will help tracks to overlap, thereby minimizing the amount of ground trafficked.

2. Strive to make all axles on all equipment have the same wheel spacing (or track spacing for tracked vehicles), or multiples of that spacing. Also, for row crop systems, strive to match the wheel spacing to the row width. For example, the wheel spacing on the rear axle of a tractor is the distance, center-to-center, between the two rear wheels (when carrying singles, not duals). The better that wheel spacing matches up across all axles on all equipment, the fewer the number of traffic lanes required to farm the field. Matching up wheel spacing's may require modifying equipment, such as increasing the wheel spacing on the front axle of tractor to match the rear axle, etc. Another important factor in planning wheel spacing is row width (i.e., spacing between crop rows). Strive to match wheel spacing to a multiple of the row width, so that wheel tracks are always located between rows, not over the top of rows. For example, wheels spaced 10 feet on center are well-suited for systems with 30" row width – the axle spans four rows of crop and each wheel is centered on the inter-row area on either side of those four rows.

3. Strive to minimize the width of all tires/tracks. This will reduce the width of each traffic lane and consequently minimize the percentage of the field that is trafficked. Another key objective is to minimize traffic on top of crop rows. For example, for row crop systems, an ideal tire width is at least 8 to 10 inches narrower than the row width (e.g., 20.8-inch tire for 30-inch rows). A wider tire could be used (e.g., 4 to 5 inches narrower than row width), but rows with traffic on both sides are more likely to lose yield. If single tires are too wide to fit between rows, consider converting to split duals that run on either side of a row or to a taller single tire. This is not required under this standard, but is recommended. Both options can improve flotation without running over a row. As the soil in permanent traffic lanes becomes consolidated, less tire/track surface area may be required to carry the same load. In this case, duals or extra-wide tires can be converted to singles, further reducing the percentage of the field and the amount of crop that is trafficked.

4. Create and implement a practical plan for ensuring that everyone who enters the field is aware of and follows the controlled traffic system. Partners, employees, and custom applicators all need instructions and reminders on where and how to enter and exit the field, what traffic pattern to follow, etc.

On vegetable or other farms where the goal is permanent raised beds with no traffic on the beds, many of the above issues come down to selecting a width for the beds and for the traffic lanes between beds. The nature of the crop(s), the size and preferences of the people working in the field, and equipment availability can all influence the choice, potentially making it very different from farm to farm.

PLANS AND SPECIFICATIONS

Plans and specifications shall be prepared for each field site where the Controlled Traffic Farming system will be installed. Record practice specifications on the Controlled Traffic Farming Jobsheet. Typically, at least two scenarios should be described and/or planned – the baseline or benchmark scenario and at least one improved alternative scenario (fill out one jobsheet for each scenario). At a minimum, plans and specifications for each scenario will include the following:

- List of all crops to be grown in the rotation, with row widths or spacing's for each crop specified (including drilled or broadcast crops).
- List of all field operations to be used for growing each of the above crops, including each tillage, spraying, spreading, planting, harvesting, etc. pass.
- List of all equipment (including tractors and towed implements) to be used for the each above field operations and the following specifications and details for each (measurements to the nearest inch):
    - Operating width (OW) (i.e., width of spray boom, width of combine corn header, width of combine grain header, etc.);
    - Wheel/tire/track spacing (WS), center-to-center (C-C), for each axle (i.e., width between tractor tires on the front axle, width between tractor tires on rear axle, etc.)
    - Tire/track type and width for each axle (e.g., single tire 21 inches wide; dual tires each 16 inches wide and 20 inches apart on center, etc.).
    - Minimum recommended tire inflation pressures (in psi) for any tire that is expected to run over harvested crop rows (i.e., any tire used in the rotation that is wider than the narrowest crop row width in the rotation). This should be based on tire manufacturer's specs and the expected load on/speed of tire under field conditions.
    - Attach to the above list at least one photographs of each piece of equipment showing OW, WS, etc.
- Diagram showing field layout and geometry of planned traffic and grow zones. The recommended method is to create this diagram by hand on graph paper or in a computerized spreadsheet.

Examples are available from VA NRCS State Resource Conservationist (SRC) staff.

- Based on the above, calculation of the theoretical total percentage of the field area in traffic zones.
- Based on the above, calculations of the theoretical total percentage of the field in non-trafficked grow zones.
- Description of technologies or strategies, such as GPS-linked guidance systems and employee communication plans, which will be used to help maintain the planned traffic pattern.

OPERATION AND MAINTENANCE

1. Maintain the traffic system according to the above plan, specifications, and diagram(s) – in particular, never traffic designated grow zones.
2. Communicate the requirements of the controlled traffic system to all new employees and custom applicators/harvesters.
3. Amend the above plan, specs, and diagram(s) as new crops and/or implements are added to the system.
4. Strive to continually reduce the percentage of field trafficked as implements are traded or purchased.

REFERENCES:

M.A. Hamza, W.K. Anderson 2005 Soil compaction in cropping systems - A review of the nature, causes and possible solutions. Soil & Tillage Research 82 (2005) 121–145.

Raper, R.L. and J.M. Kirby. 2006. Soil Compaction: How to Do It, Undo It, or Avoid Doing It: ASAE Distinguished Lecture #30, pp. 1-14. Agricultural Equipment Technology Conference, 12-14 February 2006, Louisville, KY, USA. ASABE Publication Number 913C0106.

Reeder, Randall C. 2002. Controlled traffic. Encyclopedia of Soil Science. Marcell Dekker, Inc. pp.233-236.

Reeder, Randall, and John M. Smith. 2000. Controlled Traffic. In: Conservation Tillage Systems and Management, MWPS-45. Midwest Plan Service, Ames, IA. (Pages 77-82).