NO-TILLAGE FARMING

A. History of no-tillage farming:

1. Ancient people and less developed civilization today practice no-tillage farming. Currently a slash and burn method practiced in less populated areas provides a clean seedbed and readily available nutrients. This method is dependent on a long fallow or rotation period 10-15 years.

2. The concept of completely turning the soil over and burying all plant residues was largely a development of the late 18th century (i.e. 1780's)
   a) Thomas Jefferson, math formula for the moldboard plow, 1784.
   b) Charles Newbolds patent for cast iron plow, 1796.
   c) John Deere's introduction of manufactured steel plow, 1837.
   d) Steam, followed by gasoline followed by diesel engines have brought plowing to the level we know today.

3. The beginning of the end for plowing in America.
   a) The dust bowl days of 1930’s caused by a combination of environmental and man made factors. The pioneers had cleared virgin prairie with plows; long drought and high winds changed soil to dust and carried it away. The first nation wide environmental disaster.
      (1) May of 1934, worst dust bowl year, clouds of dust blocked the sun from Texas Plains through the Dakotas.
      (2) On May 12 1934, dust shut out the sun over the East Coast for five hours.
      (3) Dust reported settling on ships 300 miles out to sea.
      (4) In 1986, lights turned on in Melbourne Australia during the day, due to dust clouds.
      (5) The environmental disaster of the dust bowl resulted in the formation of the USDA Soil Conservation Service (now the NRCS National Resource Conservation Service) to help farmers reduce soil erosion by wind and water.
4. Research during WW II resulted in the discovery of 2,4-D and related herbicides. The ability to kill plants chemically allowed for an alternative to plowing for seedbed preparation.

   a) Paraquat, imported from England in the early 1960’s, provides fast kill of above ground vegetation without leaving biologically active residues in the soil.

5. In 1966, Allis Chalmers introduced the first no-tillage planter.

6. Summary: Working the soil to provide a vegetation free seedbed for crops has always been used in agriculture. In some cases, animal power, human power or fire killed off existing vegetation. Plowing became more complete with modern machines of the late 1780-90’s. Dust bowl days of 1930’s cause a nation wide disaster, which prompted the federal government of take action. Herbicides replaced the need for the plow and now equipment designed specifically for no-tillage farming exists. The challenge for future farmers is to produce crops with reduced tillage and reduced chemical inputs.

B. The basic concepts of no-tillage farming.

1. The primary reason to plow.

   a) To provide a seed or transplant bed which is free of all other living vegetation. In this way, crops can start their growth without competition from weeds.

2. In no-tillage farming contact herbicides can kill all living vegetation before planting. In other words chemicals replace the plow.

3. In the book "One Straw Revolution", no-till farming practiced without chemicals. This farming sequence was developed described by Masanobu Fukuoka for rice production in Japan:

   a) In early October, before harvest of rice, broadcast seeding of white clover and fast-growing winter grain into ripening stalks of rice. The clover and barley sprout and are trampled during rice harvest but quickly recover.

   b) After rice is harvested and threshed, the straw is spread over the fields, in a random manner.

   c) Rice seed for next season is broadcast seeded into growing barley/white clover mixture. Seed is enclosed in a soil pellet. Roll moist seeds in clay powder.

   d) In the spring, the barley is harvested and the straw returned to the fields.
e) Water is allowed to stand in the rice fields for a week or 10 days. The flooding causes the weeds and clover to weaken and allows the rice to germinate and sprout up through the straw. The rice outgrows the weeds.

f) In this system, the floodwaters are used to setback the weeds and clover and give the rice a head start. This is similar to the use of a herbicide to kill or stunt weeds prior to seeding or transplanting with crop plants. Also, desirable crops are grown that suite the season of the year. This requires the farmer to be more sensitive to the cycle of the season and to know the best crop to grow for a particular season.

4. In Hawaii, I am told that there is no time for growing ground covers, there is no time to let the soil rest and replenish organic matter. You cannot make money any other way than the way we do it now. Classic thinking for a society on the verge of extinction.

C. Hawaiian no-tillage farming for vegetable crops.

1. The basic requirements for the system (please feel free to violate all concepts as they occur to you.).

   a) An accurate herbicide delivery system. To include adjustable boom height with fronts and back mounting of the boom.

   b) A mower that can handle high grasses (4-6 ft.).

   c) A method to spread seeds both as a broadcast planting and in rows, a source of seeds and dry cool rodent free seed storage.

   d) The hardware setup for drip irrigation and fertilizer injection.

   e) Lastly, a small disc or rotovator.

2. The crop is any crop you like with one cycle per year. More crops make separate fields.

   a) Start after your last crop of the summer, somewhere around October, November or December.

   b) Prepare the soil with a light disking.

   c) Seed a ground cover (one that can be killed later either by mowing or herbicide).

   d) You must seed a high rate to avoid weed competition with cover crop.
e) Layout drip line either on the surface or 1-2 inches below. Use thickest drip available. Thickness specified as mil, higher mil # = thicker plastic.

f) Allow ground cover to grow, mow if necessary to maintain a low height and stop seed formation. Choice of ground cover is an important management decision (management of weeds, diseases or insects.

g) Before planting the next cash crop, kill off ground cover. End result is a field with a thick layer of mulch with drip lines protected from degradation by light. Drip lines also offer direct placement of nutrients for growth of crop. Seed or transplants will be placed directly into dead ground cover with as little soil disturbance as possible.

h) To apply residual herbicide, either use granular material or make your own by binding to fertilizer of organic residue. Sprays in no-tillage have a hard time penetrating the mulch layer. Overhead irrigation can help to wash herbicides off of surface mulch and onto soil surface. If mulch is thick enough, weeds are minimal. Think of novel ways to reseed ground cover in as little soil disturbance as possible.

D. Hawaiian no-tillage for fruit or forestry.

1. You have some old cane land in Hamakua or Puna or Pahala or Wailuku or wherever.

2. If sugar and grassy weeds are present, roll, crush or mow all vegetation. When regrowth occurs, apply Roundup (in combo with Garlon for perennial broadleaf weeds), may need more than one spray application to get all perennial weeds. Old dead cane should be worked into the soil and not scrapped off into holes or gulches (this is the standard procedure in Hawaii).

3. Obtain a soil test and amend the soil for long term pH adjustment. For pH adjustment use a coarse ground coral in combination with a very fine lime. The fine lime will give quick effect and the coral will provide pH adjustment for 5-7 years.

4. The entire orchard site is seeded to a grass or grass + legume mixture and well fertilized. As the ground cover grows, it is cut and moved into future orchard planting rows. Continue this operation for a long as it takes to build a thick mulch layer.

5. At planting time, use a non-selective herbicide to kill weeds and ground cover in the future orchard row. Plant trees through the mulch with as little soil disturbance as possible.

6. Maintenance of the mulch layer will reduce the need for additional herbicide applications.