Direct Seeding in the Inland Northwest

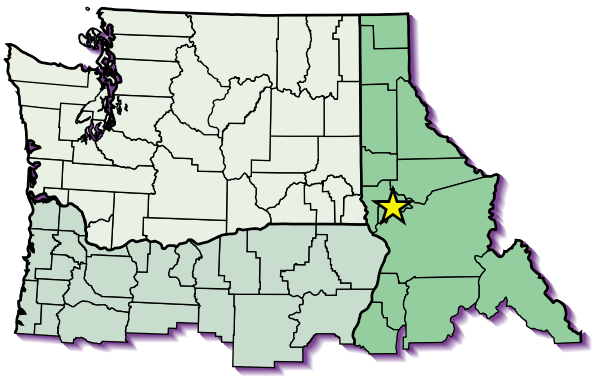
MOSMAN FARM
case study

Location: Lewis County, ID

Annual rainfall: 25+ inches

Drill types: John Deere® 750

Crop rotations: Winter wheat/Spring cereal/Broadleaf crop
Grass seed crops and alfalfa hay



David Mosman describing his direct seed system to growers on a ClearWater Direct Seeders field tour.

"Every farmer operator has seen what good soil looks like when digging a post-hole in an old fence row. That soil is clearly different from what the farmer is farming. I am interested in soil health because I have seen what that good soil can do. That is the soil I want on my whole farm."

~Dave Mosman

BACKGROUND

Dave Mosman's farm, near Nezperce, Idaho, features high rainfall, a short growing season [3,000 feet elevation], relatively gentle slopes (5% to 20%), and shallow topsoil. Dave explains, "Our topsoil is good [a dark loam with 4% to 5% organic matter], but it is only 6 to 12 inches thick. Red clay lies under that so it is very easy to create a tillage pan with conventional tillage." Perennial grasses are well suited to this environment and are Dave's most economically important crops. He also raises winter wheat, winter Canola, spring cereals, lentils, flax, linola, and alfalfa hay. Dave and his wife, Cathy, "have tried to organize the business to be primarily a one-family operation." To achieve this, he custom hires some spraying and trucking.

Dave switched to a continuous direct-seed system in 1996, after more than a decade of direct-seeding fall crops. He says direct seeding, in addition to being a good match for his shallow soils and perennial crops, allows him to achieve the production efficiency he needs to compete with larger operations. He recently

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expanded from 1,000 acres to 1,800 acres without increasing his labor needs. "Without perennials and without direct seeding, we would be in trouble on this farm. But with the two, we are doing relatively well."

Dave is an Associate Supervisor of the Lewis County Soil Conservation District Board, past-President of the Nezperce Prairie Grass Growers Association, and a member of the Board of Directors of the Idaho Crop Improvement Association and the new Pacific Northwest Direct Seed Association. He also participates in a group of innovative growers in northern Idaho and eastern Washington—the ClearWater Direct Seeders—who hold monthly breakfast meetings in the winter and field tours during the growing season to exchange experiences, ideas, and encouragement about direct seeding.

A NEW WAY OF FARMING

Two experiences early in Dave's farming career led to his interest in direct seeding. One was witnessing what healthy soil could do for crop production. "My dad and uncle raised bluegrass for seed for years as I was growing up. When those fields rotated into annual cropping after 10 or so years in grass, they were consistently our most forgiving and best yielding fields. It didn't matter if it was a wet or dry year, or if we planted the seed too deep or too shallow. We were going to raise a good crop on those soils after bluegrass. We almost couldn't mess it up. In essence, those were no-till fields. But as we continued cropping those fields annually under conventional tillage, we watched the soil structure and the yields deteriorate to the levels of the farmland around them. When I saw that happening, I had to ask, 'Is there a way to keep that soil structure and productivity indefinitely?' That is how I became interested in continuous direct seeding."

While serving on the Lewis County Conservation District Board (1984 to 1997) Dave came to realize how much more effective direct seeding could be at preventing soil degradation than the conservation practices then being promoted. "Practices such as sediment ponds, sod waterways, divided slopes, terraces, and strip farming clean up the water after it has gotten dirty. It's a better idea not to let the soil move in the first place, and to leave it on the hill where we can use it in productive ways. Direct seeding addresses the problem itself, not just the symptoms."

Dave and his father, Ray Mosman, began direct seeding winter wheat into pea and lentil stubble in 1982. Dave says, "We were sorry just about every time we did not direct-seed the fall crop because we would get more erosion, more frost heaving, and often less yield." It was not until Dave bought his own no-till drill in 1996, however, that he decided to switch to continuous direct seeding. "I was going to continue farming conventionally in the spring and direct-seeding in the fall, but after I bought the drill I realized owning all the conventional equipment plus the no-till drill was a losing proposition, economically. I could not justify having that much equipment for the acreage I was farming. I either had to go back to conventional farming, or switch to continuous direct seeding and sell my conventional equipment to reduce overhead costs. I decided to get rid of my conventional equipment and commit to at least 5 years of continuous direct seeding to see if I could make it work. In 1999, we marked the third or fourth year of continuous direct seeding on almost all of the ground. Some of it has not been tilled in 20 years."

Dave says, "It was a little less risky for me to switch to 100% direct seeding because of the fairly high percentage of ground I have in perennial crops. Those acres do not need to be seeded every year, and as they come out of production, they are already through the transition phase." Dave also feels his particular operation, characterized by shallow topsoils above clay and relatively small acreage, may have more to gain from direct seeding than larger operations on better soils. He explains, "Plowing, rodweeding and other tillage create a tillage pan that blocks root growth and keeps crops from accessing moisture and nutrients in the underlying clay. Under direct seeding, channels created by earthworms [and taproot crops] from the topsoil into the clay layer are left undisturbed, and crop roots are able to follow those channels to access late-season moisture." Dave continues, "Direct seeding allows the small farmer to compete with the big farmer. Without all the tillage, you can actually crop quite a few acres using just a small drill and a small tractor, and be economically efficient, timely, and competitive."

Dave took a studied approach to evaluating direct seeding, and to designing his own system. He read as much as he could about direct seeding in the Midwest and other countries (Canada, Brazil, and Australia), visited direct seed farms in the Dakotas and Dwayne Beck's research plots at the Dakota Lakes Research Farm, attended the annual Northwest direct seed conferences, and conferred often with neighboring direct seeders. "I'm hard pressed to come up with any single idea that I can call my own. The trick is picking and choosing what to apply to your own farm from the information out there.

If I have a problem, I take the time to observe what is at the root of the problem without just putting the blame on direct seeding. I always ask myself, 'What is the weak link here? What is the limiting factor?' Usually by isolating the limiting factor you can come up with another way to solve the problem." Designing a whole new system for his farm demands effort and patience, but Dave says, "direct seeding is not any more complicated than conventional farming. We have been farming conventionally for so long, it is second nature. We are comfortable with it. Eventually we will reach that point with direct seeding."

MOSMAN'S NO-TILL DRILL

Dave does all of his seeding using a John Deere® 750 no-till drill purchased in 1996. He chose a drill with disk openers to direct-seed into sod when rotating grass crop fields into annual production. He chose the 750 in particular because it is relatively easy to pull. "I did not have to change tractors (more capital outlay) to switch to direct seeding. I just use the 165 HP mechanical front wheel drive tractor I used with my conventional drill." The 750's one rank of single-disk openers deep band fertilizer followed by two ranks of single-disk openers that place seed and starter fertilizer. Dave switched the seed row spacing from an even 7.5 inches to paired-rows 5 inches apart with a 10-inch spacing between pairs. The deep band fertilizer goes between the 5-inch seed rows.

One of Dave's major concerns with direct seeding in the spring was "flotation—getting the drill and tractor to float on the wet soils." To address this, he says, "We put wider tires on the back of the drill, added four more tires to the front of the drill, and two more tires to the tractor. We took all of the weights off the tractor and all of the fluid out of the tires to lighten them up. It was relatively simple to do and has worked pretty well."

In 1998, Dave started experimenting with Yetter trash cleaners on his drill. He mounts two trash cleaner wheels in front of each seed opener on the third rank of openers and lifts up the second rank of openers. This gives him even 15-inch row spacing—enough room between rows to stack the residue. Removing straw from the seed row prevents straw tucking and allows the soil to warm faster. Stacking straw between the seed rows provides more mulch to suppress weeds and prevent moisture loss. "There are important advantages to trash cleaners," says Dave. "But is there a yield penalty for being on 15-inch rows. I don't think there will be for most crops." In 1999, Dave used the trash cleaners on his drill to seed 100 acres of crested wheatgrass (2 lbs per acre) directly into standing stubble of a barley crop that had been direct seeded into winter wheat stubble. "I was as far out of my comfort zone in terms of residue loads as I ever have been, and it worked well. I was able to seed shallow and get a good stand."

Mosman's modified John Deere 750 no-till drill.

CURRENT DIRECT-SEED SYSTEM

Crops and rotation

Dave grows certified grass seed and hay crops on 35% to 50% of his cropland and annual crops on the remainder. The rotation or crop sequence he uses "depends on the plans for that field. If we are preparing a field to go into grass seed, I seed spring cereals for 2 or 3 years in a row to get rid of any grassy weeds that would cause quality problems with our certified grass seed. The grass crops generally stay in seed production for 5 to 10 years. If I am returning a grass seed field to annual cropping I start with a broadleaf, lentils, to break any grass disease cycles and spray in the crop for grassy weeds. Then I try to follow basic rotation principles for annual cropping." Basics include: 2 consecutive years of spring crops to provide the opportunity to spray out winter annual weeds; 2 years between winter wheat crops to break diseases such as Cephalosporium stripe and take-all; and 3 years between winter Canola crops to avoid black leg and Sclerotinia problems.

Following these basic principles, Dave has developed a 3- (or 4-) year rotation of winter wheat/spring cereal/spring broadleaf (or chemical fallow followed by winter Canola). He stresses, "the rotation is flexible, stretched out to 4 or 5 years as the need arises, but includes as many high value crops as possible. For example, if a grassy weed shows up, I grow barley back-to-back and then a spring broadleaf

before returning to winter wheat. If I have a field with Sclerotinia, I won't plant peas, lentils or Canola for 4 to 5 years. Instead, I'll seed cereals for a couple of years, then maybe flax, then cereals again before planting any broadleaf crops susceptible to Sclerotinia. It is a 'use-your-head' rotation and a 'use-your-crops-as-tools' approach to cropping." The examples above demonstrate how Dave employs different crops to manage weed and disease problems. Others include using taproot crops, such as Canola and flax, to break up compacted soils when making a transition into direct seeding, and using crops having different seeding and harvesting dates to spread the workload and to manage time. "I like to include alfalfa hay in my operation because it comes off before anything else."

Dave grows wheat, barley, or oats for the spring cereal leg of his rotation. While spring wheat offers the highest value, oats, and to a lesser extent, barley, provide the best break from winter wheat diseases and Hessian fly. They also are easier to establish in high residue. For the spring broadleaf leg of his rotation, Dave grows flax, linola, lentils, or spring Canola. Flax and linola are new crops for Dave. After 2 years of production he is encouraged by their performance and impressed by their rotation benefits. "Flax and linola are lower risk crops than peas," which Dave stopped raising. "They do not sprout, bleach, or shatter. They are resistant to bugs. They are not susceptible to the major diseases of other broadleaf crops. They can be sprayed with a few different herbicides. They have a taproot, although small. And they seem to like being direct seeded." Dave's yields of flax and linola have averaged 1,100 lbs per acre and 1,750 lbs per acre, respectively.

Dave says winter Canola, which he has grown for 8 years, also fits well with direct seeding. "Winter Canola is very desirable to help reduce the workload in the spring. It has a heavy taproot that can break up a plow pan, and when you grow it following fallow, you have 2 years out of cereals, which cleans up the ground from the cereal diseases. Like winter wheat, it is also a fairly high-value crop." Dave has tried recropping Canola on stubble ground but says, "it was probably my greatest failure. The winter Canola varieties we now have want to be seeded in August, which almost necessitates putting them on fallow because there isn't time to get a crop off, let weeds germinate, and get the field sprayed before seeding that early. While chemical fallow can be advantageous, it is expensive so I am trying to get away from using it. But if we have a real heavy stubble year, we can use the time factor to reduce the stubble before seeding the next crop."

Residue management

Like most direct seeders, Dave's first step in managing residue is to distribute the combine residue as evenly as possible, using straw and chaff spreaders on his combine. In 1999, he added a stripper header. Dave says, "The idea behind a stripper header is to increase harvest capacity of a combine." An added benefit for direct seeding, the stripper header leaves all of the straw in place so the grower does not have to redistribute it over the field. Dave said direct-seeding winter wheat into standing flax stubble harvested with the stripper header was easier—he had less straw tucking and better seed-to-soil contact—than direct-seeding into conventionally harvested flax residue.

When Dave does not think he will be able to seed a spring crop through the residue remaining in a field, he burns the residue in the spring. He says, "I started direct seeding in the spring with the idea I had burning as an option because I knew it would work. My goal, however, is to direct seed without burning, and I'm doing less and less of it every year. In my mind, the long-term soil health benefits of maintaining the residue far outweigh the timing advantage you might get with burning. I do think burning is a tool we need to keep for dealing with the real high residue fields."

He has experimented with baling and harrowing as alternative residue management techniques, but is not satisfied with either. "The market value of straw is so low you can not afford to haul it anywhere. In my mind, it has much greater long-term value in terms of nutrients and soil quality." As for harrowing, Dave says, "I've just used a conventional light harrow on cereal stubble in the fall with the idea of knocking it down and mixing it with a little soil to aid in its

Early May stand of winter wheat direct-seeded in Canola stubble.

decomposition. I'm not sure it is worthwhile, but I have seen some good results with big heavy harrows in the area."

Dave says, "My goal is to do single-pass, low-disturbance farming. If possible, I want to leave the stubble and residue—just spread it evenly at harvest—and then come back and seed." His experience with one long-term direct-seed field on his farm gives him confidence he will eventually be able to achieve a one-pass system on the rest of his fields. "We have one field that has been in direct seeding (with no burning) for the last 20 years after 20 years in hay. When I seed that field, I get some straw tucking; in fact, I don't see any soil because it is totally covered with straw. I'm not in the comfort zone from a conventional farming point of view, but I've farmed that field long enough now that I know whatever I do, it consistently produces our best crops. I am hopeful that as I get more of the acres into a continuous direct-seed system, with the soil health benefits I am seeing, the need to burn or do other residue management will be reduced. I already feel a lot more comfortable seeding right into stubble on a field direct-seeded for 3 or 4 years, than on a field I just acquired."

Fertility

Dave bases fertilizer rates on soil tests and crop yield goals. He also takes into account that without tillage, less soil nitrogen is released from the organic matter through oxidation. To compensate, he has increased the amount of nitrogen he applies by about 20%. "Since I'm actually increasing organic matter, I need to add more nitrogen. Eventually, I think I will be able to back off, and even reduce nitrogen rates, but through the 5-year transition period I need to add more."

He uses one blend of urea, 16-20-0, and potassium chloride for both the deep band and with the seed. "I do this primarily for efficiency, but also because I want a balance of nutrients in the deep band as well as with the seed." He places about 80% of the material in the deep band and 20% with the seed. Dave varies the rate, and sometimes the blend, depending on crop needs. He uses a split application for winter wheat, applying about 75% of the fertilizer in the fall and topdressing the remainder in the spring.

Weed management

Dave was warned by a number of conventional farmers in his area that he would end up with infestations of grassy weeds if he switched to continuous direct seeding. Contrary to his neighbors' predictions, Dave says, "I have seen consistently less weed pressure with direct seeding than before." The reason? "Winter annual grassy weeds are not a direct-seed problem, they are a rotation problem." Dave designed his rotation to include 2 consecutive years of spring crops, which gives him the chance to let weeds germinate and to spray them with a nonselective herbicide between crops. Dave usually makes one application of Roundup (glyphosate) in the fall, given enough fall moisture to stimulate weed germination and growth, and another in the spring. The spring application, while essential, can present a challenge. "I want to seed as early as possible, but I'm forced to wait until the weeds germinate, grow and can be sprayed with Roundup. That gives me a later seeding date." (See "Seeding Strategy".) "My other option is to use a broadleaf crop, seed earlier, and come back with a grass herbicide to take out the grasses."

Direct-seeding spring barley into oat stubble in May (top), in a field that had been direct-seeded for 20 years after 20 years in hay. Early June stand of the barley crop (bottom).

Dave also attributes his low weed pressure to using a minimum disturbance drill. "Often weed seeds won't germinate if you don't disturb them. And even if they do germinate from the soil surface, I don't think the plant is as strong as if its growing point is in the soil. …I had read that wild oat pressure decreases under minimum disturbance, and now I can say that is true, although they don't disappear. Since I have been direct seeding, however, there have been a couple of years when I have been able to raise wild-oat-free cereals for seed without spraying. That was unheard of in a conventional farming system."

One weed that has increased on Dave's farm since he switched to direct seeding is bedstraw. "I expected bedstraw to be worse under direct seeding because it seems to do well in the grasslands around the perimeter of the farm." Dave notes that bedstraw also has increased recently on conventional fields. Whether it is associated with direct seeding or not, bedstraw is "a tough weed to manage and can be very serious in Canola because the seed is the same size as Canola seed." Dave's strategies have been to seed after weeds germinate and are sprayed with a nonselective herbicide, then to choose in-crop herbicides particularly effective on bedstraw.

Dave's biggest concern about his new weed control system is his reliance on glyphosate. "If weeds became resistant to glyphosate, this system would not work." Dave notes he and other growers can take measures to prevent glyphosate-resistant weeds from developing. "Basically, we need to use herbicides with different modes of action, and we need to be very vigilant."

Disease management

Dave says, "Disease should be a minor problem if you use resistant varieties, rotation, and sanitation. Dave used a 3- or 4-year rotation to break disease life cycles and planted resistant varieties even before switching to continuous direct seeding. Where he used to rely on tillage for sanitation, he now is careful to eliminate the "green bridge" between crops. Fall and spring applications of a nonselective herbicide achieve a weed- and volunteer-free period of at least 3 weeks, allowing soilborne pathogen levels to die back before planting a new crop. Dave thinks soil health also will contribute to disease management by producing crops better able to fight off disease. "Humans are less prone to disease if we live in a healthy environment and have all the nutrients we need. …I have already seen this effect on the field direct-seeded for 20 years."

Seeding strategy

Dave says patience is the key to spring seeding in his direct-seed system. "Through the transition period, I have to wait longer to seed than in a conventional system so I can float over the wet spots in the field. Seed placement also is better later because straw tucking is less of a problem in drier soils. Once through the transition, I can seed as early or earlier than in a conventional system [because of improved water infiltration], but I still need to wait so I can kill more weeds with the nonselective herbicide. I use the weeds to tell me when to seed. I wait until they germinate, kill them, and then I seed. My late-season crops have been as good or better than my early seeded crops. Is the higher water holding capacity of a healthy soil compensating for a later seeding date? I don't know, but it seems to."

As for seeding depth and rates, Dave says, "I tend to seed a little bit deeper if I am seeding through heavy stubble because straw tucking is less a problem the deeper you seed. On the other hand, the shallower you can seed under direct seeding, the better. The soil is warmer closer to the soil surface, and under direct seeding, the upper layer of soil does not dry out. …I have also increased my rates by about 20% with direct seeding." He adds, however, "I probably would have done that anyway were I still conventional farming because I believe there are agronomic and economic benefits to using crop competition to enhance weed control."

DIRECT SEEDING VS. CONVENTIONAL TILLAGE

Dave's switch to continuous direct seeding has affected all aspects of his farming operation, and even touched his family life. He developed a "list of less" and a "list of more" outlining what he sees are the important differences between direct seeding and conventional tillage-based farming.

- **Less capital investment.** "This is probably the key advantage of direct seeding. I have less capital invested in equipment and it is spread over more acres, so my overhead costs are substantially less." In 1994, when Dave was direct seeding in the fall and seeding spring crops under conventional tillage, his overhead costs (costs not allocated to specific crops) were $87 per acre for his 1000 acres. Under continuous direct seeding of all crops, he was able to expand to 1,800 acres, and

his overhead costs dropped to $45 per acre in 1999. "I'm really excited by these numbers. There's not much in agriculture that can have such a dramatic effect on costs, not to mention the environmental benefits of direct seeding."

- **Less tractor time and fuel.** "I am farming 1,800 acres, with fewer tractor hours than when I farmed just 1,000 acres. That means I'm using less labor and less fuel per acre." Dave's fuel bill was $8000 for 1000 acres in 1994 when he conventionally seeded spring crops and direct seeded fall crops. In 1999, when his farm expanded to 1,800 acres and he was direct seeding all his farm, his fuel bill only increased to $9,000.
- **Less rock picking.** "We have a lot of rocks in this area, and tillage tends to bring them up. With direct seeding, I don't need to spend the time or have the equipment to pick rocks because it is just not a problem. I know farmers who have more invested in rock picking equipment than I do in my drill."
- **Fewer weeds.** See "Weed Management."
- **Less maintenance of equipment,** "because I have less equipment."
- **Less erosion.**
- **Less frost heaving.** "Even a thin layer of residue on top of the soil surface reduces fluctuations in soil temperature from night to day so you have less frost heaving."
- **More fun**. "It is very satisfying to direct-seed into a stubble field and know it is going to come up. You make one pass over the field, you have hardly any dust, and you know when you are done that the next time you will be in that field (other than in-crop spraying, if needed) is at harvest. That is much more fun than the conventional system of fall plowing, cultivating, fertilizing, cultivating again, seeding, and harrowing, not to mention switching equipment between all those operations. Then you still have to go back to pick rocks."
- **More free time.** "I have more time to farm more acres and more time to spend with my family."
- **Better crop quality, and equal or greater yields.** "I have noticed consistently higher quality crops than before. For instance, in 1998 this area did not have much good malting barley, but ours was 80% plump. We also have had as much, if not more, yield than when I was farming conventionally. I think it is a function of soil health, improved moisture availability, and fertilizer placement."
- **More soil organic matter.** "Before direct seeding my organic matter tested consistently below 4% and now it tests consistently above 4%. It is hard to believe the change could happen so fast, but I suppose it is because I have perennial crops in the rotation."
- **More available moisture.** "I have noticed more moisture with the soils that have started to make this transition. That deep moisture wasn't accessible to the conventional crops because of the plow pan that tillage creates. Under direct seeding, water is able to infiltrate to the clay layer below the topsoil through channels made by earthworms and taproot crops, and then the new crop roots can follow the moisture through those same channels."
- **More soil life.** "I have noticed the earthworm population increases tremendously in the first year and then steadily after that. Earthworms like residue on the soil surface and they like to be undisturbed." Earthworms are an indicator of other soil life and beneficial to soil quality. On the downside, Dave has noticed more mice and slugs.
- **More wildlife.** "More wildlife is cool—I see more bird nests and deer—but bad things go with it too. I have a lot more antlers in the field. Antlers flatten tires, and flat tires are down time. Now I ride my fields in the spring to pick up antlers."
- **More time scouting fields and observing.** "I spend a lot more time watching what is happening in the field. I am always trying to figure out what is the limiting factor of the system."
- **More chemical applications.** "One variable cost that has increased is spraying application. We spray Roundup more often, but that is offset by fewer passes with tillage equipment, which are more expensive." Dave also found that in some cases he is not applying any postemergence herbicides because of lower weed populations.
- **More fertilizer and seed**, "at least during the transition years."

David describing his field of winter wheat after flax in the 4th year of direct seeding.

ADVICE TO NEW DIRECT SEEDERS

"**Educate yourself.** Start by doing a lot of reading. Go to the Direct Seed Conferences. Get a subscription to No-Till Farmer magazine. Visit Dwayne Beck at the Dakota Lakes Research Farm and the direct-seed farmers in that area. But don't expect researchers or anyone else to develop the system for you. Just as in conventional farming, the direct-seed system you develop will be unique to your farm."

Convert to 100% direct seeding as soon as possible, given that you reach a certain level of knowledge and comfort with direct seeding. "Earlier adopters will realize the most benefit from direct seeding. You will not gain the economic advantages of direct seeding until you sell your conventional equipment." Dave warns, "And the longer you wait, the less value you will get out of your conventional equipment."

Keep track of your production costs, both fixed and variable, before and during the transition to direct seeding so you know how your changes are affecting your bottom line. "It has been very exciting to watch our fixed costs go down. If we had not kept track of costs, we wouldn't be able to see that."

Follow a perennial. "Following a perennial crop or CRP is a great way to start because the ground is already through the transition. If you can't follow a perennial, start with winter Canola. The taproot will help break up the soil and establish root channels. Then direct-seed winter wheat." That gives the soil 2 years of direct seeding before you try direct seeding in the spring.

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