

## Transcript for Peanut Seed Lecture

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### Slide #1 (cover slide) – Handling Peanut Seed: A Sensitive Issue

Slide #2 – Introduction – The scientific name for peanut is *Arachis hypogaea* and it is in the Fabaceae, or legume, family. Other crop members of this family include soybean, clover, lespedeza, and cowpea. Peanut is a pea, not a nut. Peanut is called groundnut in most countries, mani in South America, and cachuate in Mexico. The USA and Australia are the only countries to refer to the crop as peanut. It is a native of South America and the center of origin is believed to be in the central portion of the continent, in the area of Uruguay, Paraguay, and Bolivia.

In the USA, peanut is separated into four market types: Virginia, Runner, Spanish, and Valencia. The Virginia market type is characterized by the large seed size. It is produced in what is referred to as the V-C (Virginia-Carolina) area, consisting of southeastern Virginia, eastern North Carolina, and South Carolina. The majority of Virginia-type peanuts are used for the in-shell roasting market. The runner market type is produced primarily in the southeastern USA in Georgia, Alabama, Florida, and Mississippi. Runner peanuts are used in peanut butter (50% of production), snack nut (25%), and candy (25%). The runner peanut market type is also grown in Texas, Oklahoma, South Carolina, and to a lesser extent, North Carolina and Virginia. The Spanish market type is grown primarily in the southwest production region of Texas and Oklahoma. Spanish peanut is produced primarily as a snack nut and is recognized for its smaller seed size and red testa, or seed coat. The Valencia market type is produced in eastern New Mexico and is produced for the fresh market trade, particularly for boiling. Valencia peanuts are physiologically different in that it has three to four seed per pod while Spanish, runner, and Virginia market types have two seed per pod. Valencia peanuts have a dark red to purple testa. Runner and Virginia peanut seed have pink or tan testa.

Slide #3 – Planted Acres of Selected US Crops – Peanut is a minor crop, relatively speaking, in the USA. Acreage typically ranges between 1.2 and 1.7 million planted acres annually, compared to approximately 75-80 million acres of corn and soybean and nearly 60 million of acres of wheat. The USA is the third largest producer of peanut in the world behind India and China.

Slide #4 – Map of USA Peanut Belt – Peanut is produced on sandy soils in a belt from southeastern Virginia to eastern New Mexico. Peanut requires a long growing season of approximately 150 days. The major production area is the coastal plain soils of Georgia, Alabama, Florida, and Mississippi. The largest concentration of acreage is south Georgia, southeast Alabama, and the Florida panhandle. Approximately 70% of the USA acreage is produced in that tri-state region.

Slide #5 – Planted acreage in 2005 and 2006 – Planted acreage is typically a response to markets and consumer demand. In 2005 there was just over 1.6 million planted acres in the U.S. and in 2006 there was just over 1.2 million acres of peanut planted in the U.S. The drop of 400,000 acres in one year was a result of a good production year in 2005 and above average carry over stocks from 2005 to 2006.

Slide #6 - Peanut seed lot uniformity and quality may change during harvest, curing, storage, shelling, conditioning, and handling. Special care must be taken during all phases of handling to ensure high quality seed.

Slide #7 – Peanut seed are typical of dicot legume seeds. They have two cotyledons and an embryo. The embryo consists of the plumule, hypocotyl, and primary root. The testa is thin and fragile.

Slide #8 – This picture of treated peanut seed show the range in seed size that can occur. For both seed and the edible market, peanut seed pass over metal screens with standardized size openings to provide uniform seed sizes. Seed that pass through a  $21/64^{\text{th}}$  by one-inch size opening and ride an  $18/64^{\text{th}}$  by one-inch opening are classified as “medium” seed size. This designation is for both edible kernels and seed production. The “medium” seed size is most desired for both uses. Research has shown that seed passing through the  $18/64^{\text{th}}$  opening and riding the  $16/64^{\text{th}}$  opening are less desirable for seed. This seed size is called “number 1’s”. Smaller seed are less mature physiologically and have a lower germination rate. Seed size can vary from cultivar to cultivar. Some cultivars produce a higher percentage of “jumbo” kernels, which are those seed that ride the  $21/64^{\text{th}}$  opening, while some cultivars produce a higher percentage of “medium” and “No. 1’s”. Seed size in peanut is a genetically controlled trait. “Jumbos” are valuable for the edible market and not as desirable for the seed market.

Slide #9 – From a physiological standpoint, the peanut plant will be in a vegetative stage of growth during the first 35-40 days after planting, after which time it will enter into the reproductive growth stage. Peanut has an indeterminate growth habit, which means it will continue to add vegetative growth the remainder of the growing season. In the first 5-6 weeks of the season the plant adds a small percentage of its total vegetative mass. The peanut flower is a perfect flower, containing both male and female parts. Peanut is a highly self-pollinated plant.

Slide #10 – When the peanut flower opens, or spreads its petals, the pollen grains are mature and are shed to begin the fertilization process. This occurs in the very early hours of the morning. The pollen grains then travel down the pollen tube, which is inside the flower stem, and the first two mature pollen grains that reach the ovary fertilize the ovules.

Slide #11 – The fertilized ovary then extends from the axillary bud and looks like an extra stem growing from the lateral branch. In peanut, the gynophore is referred to as a “peg”. The peg grows toward the soil surface and extends one to three inches into the

soil. The tip of the peg takes in water and nutrients and swells to become the fruit, or peanut pod.

Slide #12 – This picture shows several “pegs” reaching from the lateral branches of the peanut plant into the soil surface. One of the primary reason peanut is grown on sandy, or loose textured soils, is that the tip of the peg must be able to penetrate into the soil surface where it can swell and become the fruit, or peanut pod. There can be more than one peg at each axillary bud. There is usually one or two pegs, and on rare occasions, three.

Slide #13 – This picture is a cut away of the soil showing a peanut plant in mid season with a good fruit load in various stages of development. You can also see the yellow blooms in the plant. As the plant adds to its fruit load, it shifts its energy from adding additional fruit to filling out the fruit it has produced to that point. Being an indeterminate fruiter, it has fruit of various sizes as it approaches the end of the growing season. Also very visible in this image is the prostrate, or lateral growth habit of a peanut plant.

Slide #14 – The stages of fruit development are illustrated in this slide. Typically, it takes 85-90 days for the fruiting, or reproductive stage to go from initial bloom to a mature pod.

Slide #15 – Peanut seed development is highly dependent upon an adequate amount of calcium and boron.

Slide #16 – The University of Georgia recommendation for calcium for peanut seed production is to apply 320-400 pounds of calcium per acre when the reproductive stage is initiated. This is referred to as early bloom. The most desirable calcium product to apply is calcium sulfate, also known as gypsum or landplaster.

Slide #17 – A typical fertilizer spreader can do an excellent job in spreading gypsum. Most gypsum products contain 17-23% calcium. Therefore, the producer would need to apply 1,600 – 2,000 pounds of gypsum per acre.

Slide #18 - The finer ground gypsum products work best as far as spreading and solubility is concerned. Calcium carbonate, or lime, is not recommended because it is much slower in releasing the calcium for availability to the developing pod. The pods are 1-3 inches deep in the soil so the calcium sulfate needs to be more finely ground to move through the soil pores more readily. Another reason for using calcium sulfate instead of calcium carbonate is that  $\text{CaSO}_4$  does not raise the pH of the soil.

Slide #19 – One of the symptoms of inadequate calcium besides poor seed germination is pod disease. In this slide you can see pod rot caused by one of several fungal pathogens in the soil.

Slide #20 – The most detrimental calcium deficiency symptom as it relates to seed production is “black heart”. Inadequate calcium will result in the embryo not developing properly and dying.

Slide #21 – Scientists at Auburn University conducted research that showed the correlation between calcium content in the seed and germination. The recommended level of calcium in the seed is 320 ppm for 95% germination.

Slide #22 – In this slide the effect of boron deficiency is clearly evident in the peanut seed on the right. This condition is referred to as “hollow heart”. The boron recommendation for peanut seed production is to apply boron at 0.5 (one-half) pound per acre of elemental boron. Any number of boron products will work. The boron needs to be applied prior to initial bloom as boron is also a critical element in regards to pollen tube development in the ovule fertilization process. Producers should be warned not to apply in excess of 0.5 pounds per acre of elemental boron as it will cause foliage injury or burn.

Slide #23 – The seed are connected to the inner hull by the funiculus. This structure is responsible for the transfer of water and nutrients to the seed from the outer hull layer.

Slide #24 – As the growing season progresses, an individual peanut plant will increase in percentage of mature pods compared to immature pods. The University of Georgia recommends that all fields designated for seed production be irrigated. Peanut has a high water requirement. Water is needed to move the calcium already in the soil and the calcium in the calcium sulfate to the surface of the pod for direct absorption. Lack of water can be the most important factor in producing low germinating seed, especially as it relates to calcium nutrition.

Slide #25 – This slide shows a cross sectional view of a mature peanut pod with seed. The hull layer is now very thin and the embryo can be seen in this healthy peanut seed. The question is how do you know when the peanut crop is ready to harvest when the fruit are below the soil surface?

Slide #26 – In this slide the four images show the key aspects of determining when to harvest a mature, high yielding crop. In the upper left, you can see a cutaway profile of a plant with the pods below the soil surface. The image in the upper right shows a pocket knife scraping away the outer hull layer to reveal the mesocarp. It is in the mesocarp that the hull changes colors as it matures. Scientists with the University of Georgia and USDA developed a system in the early 1980's that provides a quick method for determining when a peanut field is reaching optimal maturity. It is based on revealing this mesocarp color change. The image on the bottom left shows the mesocarp when the entire exocarp is removed and the progression of color change as the pod matures. The image on the bottom right shows the inner hull color change that corresponds to the mesocarp color change. This method of determining peanut maturity and when to initiate harvest is the Hull-Scrape Maturity Profile method. When first developed the exocarp was scraped with a pocket knife to reveal the mesocarp color.

Slide #27 – The exocarp (outer hull layer) can be quickly and efficiently removed from the peanut pod by blasting them with water from a pressure washer at approximately 1200 psi.

Slide #28 – Several peanut plants are pulled from the soil from three random locations in a field. All pods from these plants are pulled off and placed in a mesh basket. The pods are blasted with a pressure washer for 1-2 minutes. A turbo blaster nozzle that creates a swirling motion of the water must be used to prevent the high pressure from tearing the pods open. This process is much quicker than scraping each individual pod with a knife. The color of the mesocarp ranges from white to yellow to dark yellow to orange to brown to black as it matures.

Slide #29 – The pods are then placed on a Hull-Scrape chart. Each pod is placed in the column that most closely represents the darkest color of the mesocarp. Once every pod is placed on the chart, a “profile” is established. This profile indicates the rate of maturity. To interpret the profile, start on the far right of the chart and move across until you find the column which has three pods. The number at the bottom of that column is the number of days until the harvest process is initiated. In this sample, the profile indicates that harvest should begin in approximately 10 days. The profile of this sample is typical of a mature sample in that a high percentage of the pods are in the brown and black columns with relatively few pods in the yellow and white columns. On the profile chart, two columns represent one week. Harvesting at optimal maturity is critical for obtaining high yield, quality, and mature seed for high germination rates.

Slide #30 – Peanut harvest is a two step process. First, the peanut plants must be dug from the soil to expose the pods to sunlight and begin the curing process. This picture shows a peanut digger-shaker-inverter in a south Georgia peanut field. This piece of equipment is so named because it digs the peanuts from the soil, shakes the excess dirt from the pods, and inverts the plants so the pods are exposed to sunlight and wind for moisture reduction (curing). When a field is dug, the moisture content is typically over 40% in the kernels. For the second step in the harvesting process, the moisture content in the kernels needs to be in the range of 12-18%. It usually takes 3-4 days of clear days with low humidity after digging for the moisture content to drop enough for the threshing process. Cloudy, and or rainy weather, extends the time needed for proper curing. This can result in lower seed quality.

Slide #31 – The second step in the harvesting process is the threshing. The peanut combine takes in the entire plant and separates the pod from the vines. The vines are blown out the back of the combine on to the soil surface while the pods are blown into a basket. The combine is referred to as a peanut picker and the process is called “picking peanuts”. When the peanuts are dug, two planted rows are thrown into a single windrow. The combine in this picture is a six-row picker, which has become standard across the USA peanut belt.

Slide #32 – This is a four-row combine. There are also eight-row combines. There were two-row combines for many years but they are no longer made.

Slide #33 – When the basket of a peanut combine is full, the peanut pods are dumped into a peanut wagon. These wagons, or trailers, have a floor that is approximately one foot from the bottom of the trailer. The floor of the trailer has a mesh bottom, which allows air to be forced up through the pods to remove excess moisture. It is important to level the top of the peanut load so the air can move equally through the pods. Uniform moisture through the trailer is critical for high quality seed. Pockets of excessively wet or dry pods can result in poor quality seed. Kernels that are below seven (7) percent moisture are very susceptible to skin slippage and splitting. Kernels that are above 10% moisture are susceptible to mold.

Slide #34 – This close up of peanuts in a trailer indicates another concern in seed production. You will notice some peanut seed, or kernels, not in a shell. In the combining process, if the combine is set too aggressively, it will literally shell the peanuts, exposing the kernels to the environment well before they are ready. These are referred to as “loose shell kernels”, or LSK’s and if the grading procedure indicates the level of LSK’s in a sample is in above four (4) percent, the producer receives a deduction on the value of that load.

Slide #35 – One huge concern in peanut production in general, but even more critical in seed production, is weed control. Of special concern are weeds that produce fleshy fruit. An example is bur gherkin. If the fruit of bur gherkin get in a peanut trailer and are crushed, the fruit release excessive moisture that can trigger mold development.

Slide #36 – In this picture of a 21 foot trailer the load has been filled to excess so that it can not be leveled for proper curing. High quality seed are dependent upon uniform moisture through out the load.

Slide #37 – The peanut trailers are then pulled to a peanut buying point. It is at the peanut buying point that the peanuts are sampled and graded by USDA Federal-State Inspection Service personnel. The grade a trailer load of peanuts receives also dictates the value of that load. For example, if a producer brought in a 14 foot trailer with 5 tons of peanuts and the Federal-State Inspectors determined the “grade” for that load was a 72 TSMK, that value means that 72 percent of that five tons was total sound mature kernels, or peanut kernels that could be used for seed or the edible market.

Slide #38 – In the past few years there has been a move to cure peanuts in semi-trailers. The concept of curing remains the same as in the 14 or 21 foot trailers, that is to uniformly and efficiently remove moisture from the pods down to 10.5%, the level at which all peanuts are graded. The advantage of the semi-trailers is that producers with large acreage are not in need of as many of the smaller trailers and it requires less labor.

Slide #39 – This picture shows a typical buying point with the semi-trailers pulled under the sheds for the curing process.

Slide #40 – The dryers used for forcing heated air through the trailer loads of peanuts typically use LP or natural gas to heat the air. The peanuts have to be monitored around the clock to make sure the moisture level is reduced at the proper rate. In the southeast USA, there can be warm days and cool nights during the harvest season and the temperature of the air being forced through the peanuts must never exceed 15 degrees Fahrenheit above ambient temperature. If the temperature is set too high the kernel moisture content will drop too low, which would result in poor seed quality. This can be the most crucial aspect of handling seed peanuts. The rate at which the moisture is lowered must be slow. If the rate of curing is too fast the testa will slip. If the testa is not intact, the seed treatment will not adhere to the seed.

Slide #41 – This picture shows the area on the back of a peanut trailer on which the dryer is attached.

Slide #42 – The two most critical factors in peanut seed quality after harvest are: (1) follow proper curing and storage recommendations, and (2) maintain the proper moisture levels.

Slide #43 – Once the peanuts have been graded and cured they are dumped into a pit where they are transferred through a cleaner to remove excess foreign material.

Slide #44 – The peanuts are transferred from the dump pit, through the cleaner, then over into a warehouse where they are stored until it is time to begin the shelling process.

Slide #45 – Warehousing can be in a typical pitched roof frame structure, which is typical, or in a geodesic dome. Warehouses must be kept clean as possible. Moisture and humidity control are the most critical factors in storing peanuts before shelling.

Slide #46 – Domes are now being used by some peanut handlers. They have the advantage of better temperature and humidity control compared to pitched roof warehouses.

Slide #47 – In a dome the peanuts are fed through the roof and the stack forms a pyramid. Temperature and humidity are monitored continuously.

Slide #48 – This shows the inside of a peanut shelling plant. The purpose of the shelling plant is just as the names implies, it shells the peanuts by removing the hulls from the kernels. There are numerous working parts in a shelling plant and peanuts being shelled for seed must be carefully monitored in order to minimize split kernels and skin slippage.

Slide #49 – Farmer stock peanuts fall through a series of rounded grates that rotate and cause the shell to separate from the kernels, or seed.

Slide #50 – This picture shows the grates that fit in a cylinder and the peanut pods tumble around and the rubbing action “shells” the peanuts.

Slide #51 – The peanut kernels then travel down a series of belts where they flow over gravity tables. The gravity tables separate out the heavier foreign material, especially small rocks that are similar in size to peanut kernels.

Slide #52 – After traveling down the gravity belts the kernels ride over a series of metal screens. The holes in these screens are cut at various sizes to allow the flexibility of screening for very specific seed sizes. For the runner peanut market type, the seed sizes are jumbo, medium, and Number 1's. The size that is best for seed is the medium seed size. The medium seed size is described as those kernels that will fall through a  $21/64^{\text{th}}$  inch diameter opening and ride an  $18/64^{\text{th}}$  inch opening. In the peanut trade it is referred to as minus (-) 21, plus (+) 18. Seed that fall through the  $18/64^{\text{th}}$  inch opening and ride a  $16/64^{\text{th}}$  inch opening are referred to as Number 1's. University of Georgia research has shown that kernels that will ride a  $17/64^{\text{th}}$  inch screen are acceptable for seed but those that would fall through a 17 screen and ride a  $16/64^{\text{th}}$  inch screen are unacceptable for seed. Seed size is related to maturity and 16's typically have a higher percentage of immature seed that would not germinate.

Slide #53 – After the seed are screened for the desirable seed size, they are funneled into a one ton polyethylene bag for storage. The bags have replaced cardboard boxes as a storage unit.

Slide #54 – The bags of seed are then placed in cold storage at approximately 40 degrees Fahrenheit until time for treating and bagging.

Slide #55 – The most common method of transporting peanut seed from the shelling plant to the treating facility is via semi-trailer.

Slide #56 – Vitavax PC was the seed treatment used for many years. It was an industry standard.

Slide #57 – In the past couple of years the peanut seed industry has switched to Dynasty PD by Syngenta and Trilex Optimum by Bayer Crop Science.

Slide #58 - University of Georgia research has shown that Vitavax PC, Dynasty PD, and Trilex Optimum are equal in their effectiveness as a seed treatment and there was no difference in rate of seedling emergence among the three.

Slide #59 – Research also indicated no difference in seedling vigor among the different seed treatments, and

Slide #60 – no difference in yield among the different seed treatments. Producers do not have to make the decision on which seed treatment is applied, as long as one is used. The seed handlers, typically the peanut shellers, make the decision on which treatment they will purchase and apply to the seed.

Slide #61 – One of the major concerns in regards to seed pathogens is *Cylindrocladium parasiticum*, known as Cylindrocladium black rot, or CBR. This is a devastating disease in the field and can be seed transmitted. Treated seed do not transmit CBR. In this picture normal seed are on top and the CBR infected seed are on the bottom. The CBR microsclerotia are visible to the naked eye.

Slide #62 – The seed treatment process starts when the seed are transferred via a spiral column from a holding tank onto a belt to be fed into a treating tank.

Slide #63 – The seed travel down the belt and fall into the treating tank.

Slide #64 – Here is a close up of the seed falling into the seed treater.

Slide #65 and #66 – The next two images are of the seed going through the seed treater. They are gently tumbled to more evenly distribute the seed treatment. Peanut seed will split easily if handled too roughly. They will also split if they are too dry. It is imperative that the seed move slowly and gently down the belts and through the treater to avoid splitting. The biggest concern of a producer is having too many “baldheads”, or skinless kernels, and “splits” in a bag of seed. “Baldheads” and “splits” typically do not germinate.

Slide #67 – The majority of peanut seed are sold in 50 pound bags. This image shows a bag about to be placed in position to receive seed after they exit the seed treater.

Slide #68 – A random sample of seed is collected for seed quality analysis. Most seed suppliers will send seed samples to the State Department of Agriculture Seed Lab as well as to one of several private seed labs located in the southeastern United States.

Slide #69 – The 50 pound bags are stacked onto pallets for storage and transportability. Over the past couple of years there have been a few producers request their seed be handled with seed tenders that hold approximately one ton of treated seed.

Slide #70 – The pallets of seed are shrink wrapped and stored in a cool and well ventilated warehouse. One of the unique aspects of the peanut industry is that the seed is also a very nutritious and delicious food. The value of the peanut kernel as an edible food product is higher than it is for seed. The peanut shelling industry will closely monitor the intended planted acreage and the producers’ demand for the different cultivars before treating a seed lot. The sheller knows that the kernels can be sold into the edible market as long as the seed is not treated. Therefore, most seed handlers will treat seed on an as needed basis as the planting season nears. They know once the seed has been treated, it must be used as seed.

Slide #71 – Pallets of seed peanuts are transported from the treatment facility to the producer or a buying point in close proximity to where they are needed.

Slide #72 – Every lot of peanut seed sold have been germination tested. The minimum germination required by the Georgia Department of Agriculture is 75%. However, good

quality peanut seed typically germinate around 90%. Other tests, such as accelerated aging, TZ, and cold test can also be run but usually are run only in the event there is a question of poor seed quality based on poor field emergence and a seed complaint by the producer.

Slide #73 – This image shows a good quality peanut seed with a uniform, straight radicle.

Slide #74 – Another critical aspect of peanut seed quality is how the seed are poured into the seed hopper. As mentioned earlier, peanut seed are susceptible to splitting and if handled roughly they will split. We always recommend that a 50 pound bag of peanut seed be handled as if it were full of raw eggs and you did not want to break a single one. Once the producer acquires the seed from the handler, it is their responsibility to store and handle the seed properly. They must be placed in a cool, dry place and handled gently when stacking and moving.

Slide #75 – When a producer looks in the seed hopper after pouring in the seed there should be a very minimal amount of white showing, which would indicate “baldheads” and “splits”. This image shows very good quality seed ready to plant.

Slide #76 – Peanut seed are sensitive to soil moisture and planting depth. Seed should be planted into soil with above adequate moisture. Peanut seed must imbibe 35% of its weight to initiate the germination process. The recommended planting depth is 2 to 2 ½ inches. There must be excellent seed to soil contact. The soil temperature must be an average of 65 degrees F at the four-inch depth for three consecutive days or longer before planting. Peanut seed are very sensitive to soil temperature. Germination and emergence rate is much better as the soil temperature at the four-inch depth exceeds 70 degrees F.

Slide #77 – Invariably, seedling problems occur, a number of biotic and abiotic factors can affect seed germination and plant emergence.

Slide #78 – Determining the cause of seed problems may be difficult. The trick is to not rule out anything until the cause is determined. Producers should be encouraged to save some seed from each lot they plant in case they need to have the seed tested after planting.

Slide #79 – The recommended seeding rate for runner type peanut is six (6) seed per foot of row on 36 to 38-inch spaced rows. The ultimate goal is to have a final plant stand of four or more plants per foot of row. Runner cultivars range in size from 650 to 850 seed per pound. A cultivar that averages 750 seed per pound and planted at six seed per foot of row on a 36 –inch row pattern would result in 116 pounds of seed planted per acre.

Slide #80 – Producers are strongly encouraged to purchase and plant certified seed. In this picture you can see the huge difference in rate of emergence between grower saved seed and foundation seed.

Slide #81 – And finally, sometimes we see problems in the field and we follow up on the germination tests only to find out that seed quality deteriorated in a short period of time. A producer gets very upset when they are sold seed that had a germination of 90% when tested in the winter and they end up with an unacceptable stand. After follow up testing revealed germination rates in the upper 70's it was obvious the handler had an issue with storage and handling. The seedsman had worked closely with their seed producers the previous year to make sure they did all the right things to produce high quality seed, such as irrigating when needed and making sure calcium was applied at the recommended rate. However, the manner in which these seed were stored and handled was not adequate and the seedsman realized they had made a serious mistake. They have since gone back into their storage facility and re-evaluated their handling procedures to, hopefully, eliminate the problem.

Slide #82 - Good peanut seed quality does not just happen. Peanut seed are very sensitive and must be handled as such. There are numerous ways in which seed quality can be affected. Seed producers and handlers must make sure high quality seed is the ultimate goal in every step of the process from planting the seed crop the previous year until the seed are planted the following year.